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MODERN Irrigation

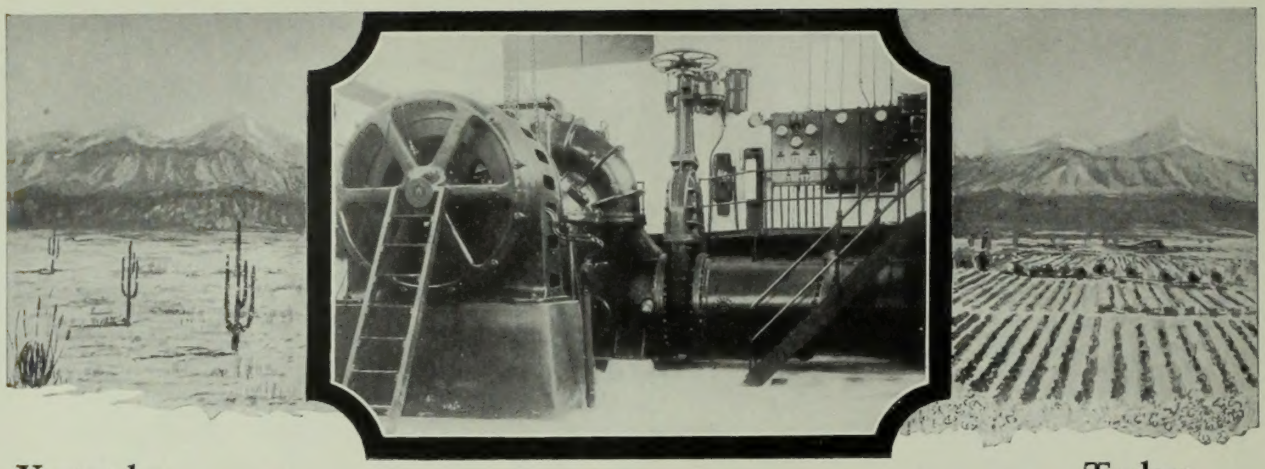
The Magazine of Applied Hydraulics

Vol. I JULY, 1925 No. 1

STORAGE RESERVOIRS OF NATURE—A TYPICAL SCENE IN PARTS OF THE IRRIGATION COUNTRY

Per Copy: 20c Published at 626 SO. SPRING STREET, Los Angeles By the Year $2

An Organized Voice for the Forces of Agriculture and Industry Which are Primarily Dependent Upon Irrigation



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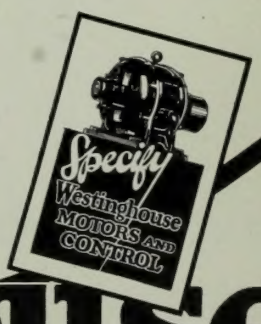

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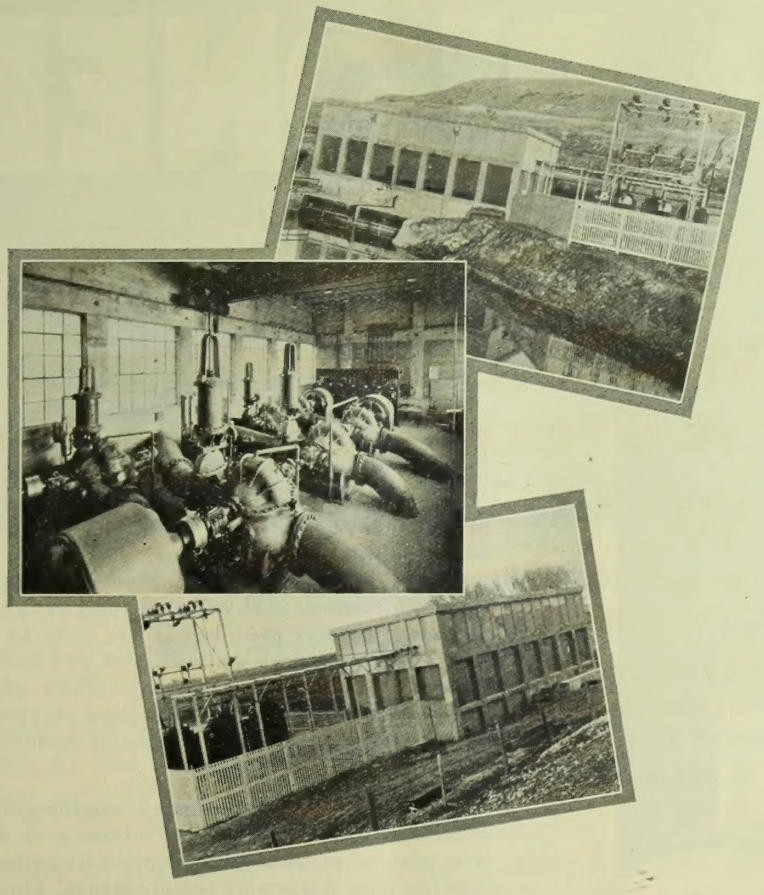

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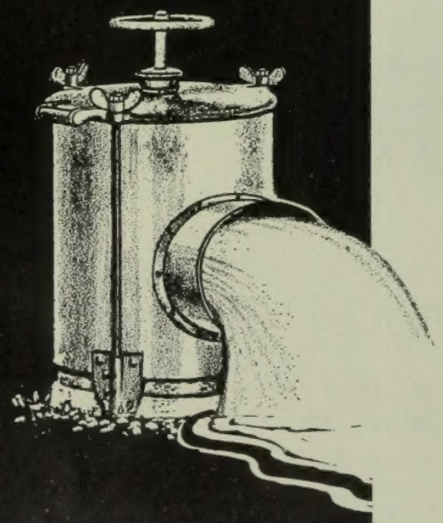

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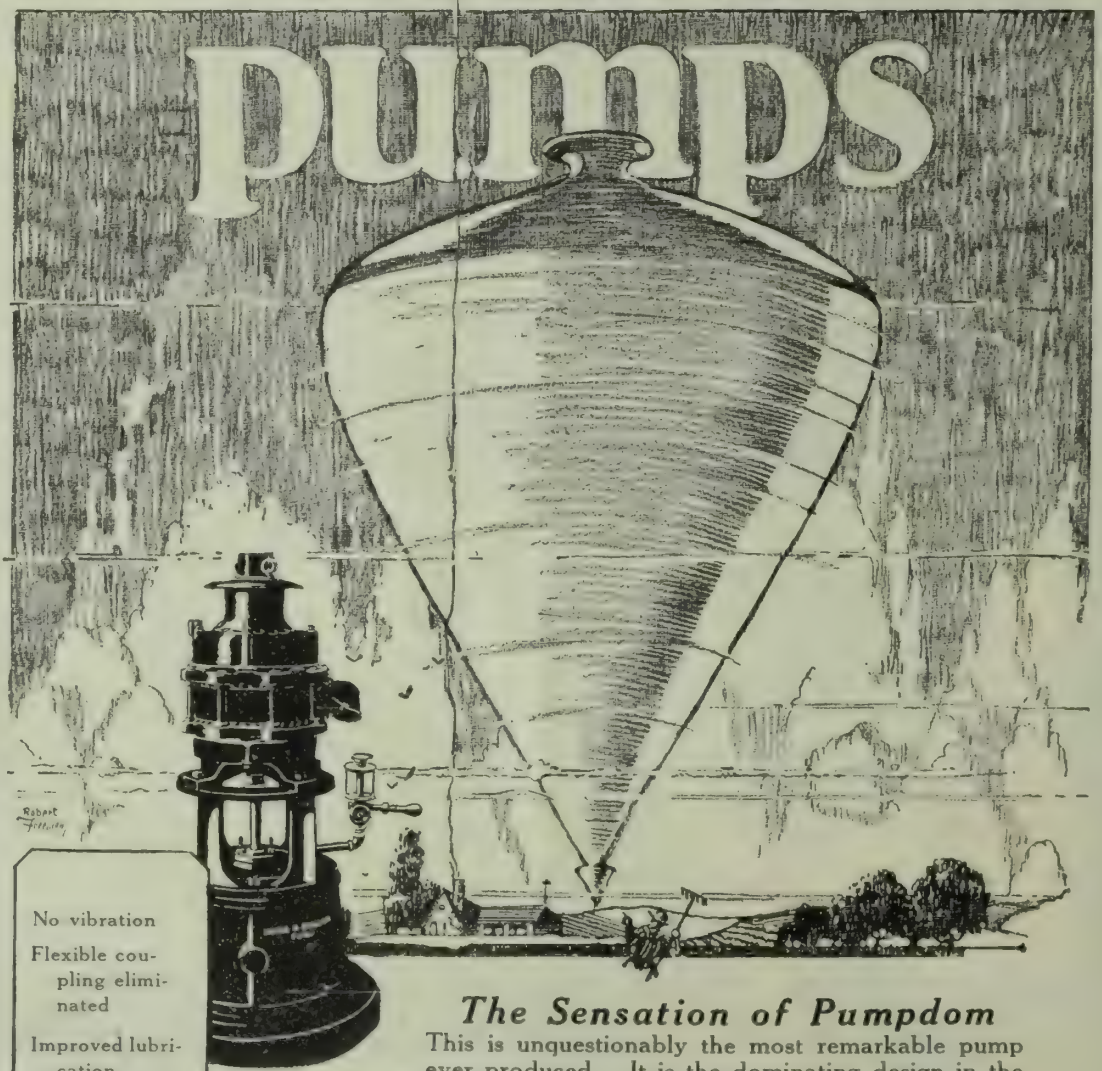

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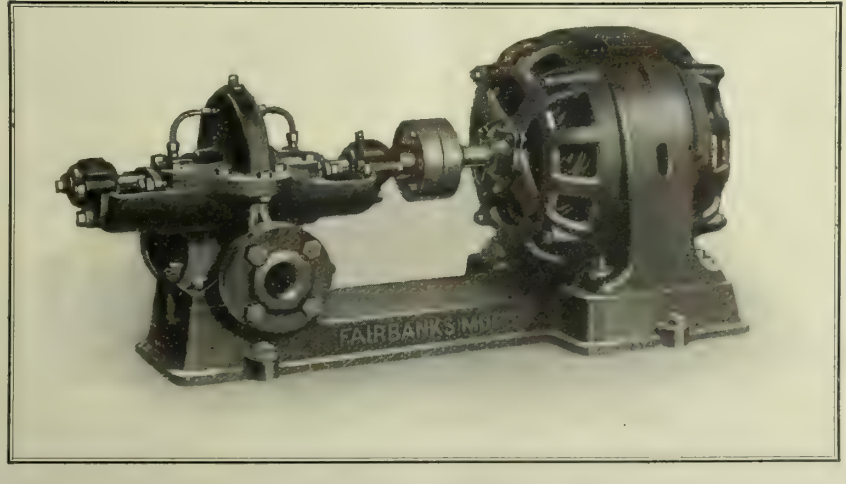

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N. B.--Several of the above groups are not complete at this writing. It has been suggested, by several of the Board members, that special groups should be formed to represent "Irrigation Finance" and "Public Utilities." A number of men have been suggested for membership on one or another of the present groups, and they are being considered with reference to their special qualifications. All groups are subject to enlargement hereafter, in order to insure strong representation for each important phase and division of irrigation and its allied interests; and in order that other sections may have representation commensurate with the status of hydraulic development in such sections. See "A Voice for Irrigation," on pages 11, 12 and 13, and explanatory article on pages 14 and 15.

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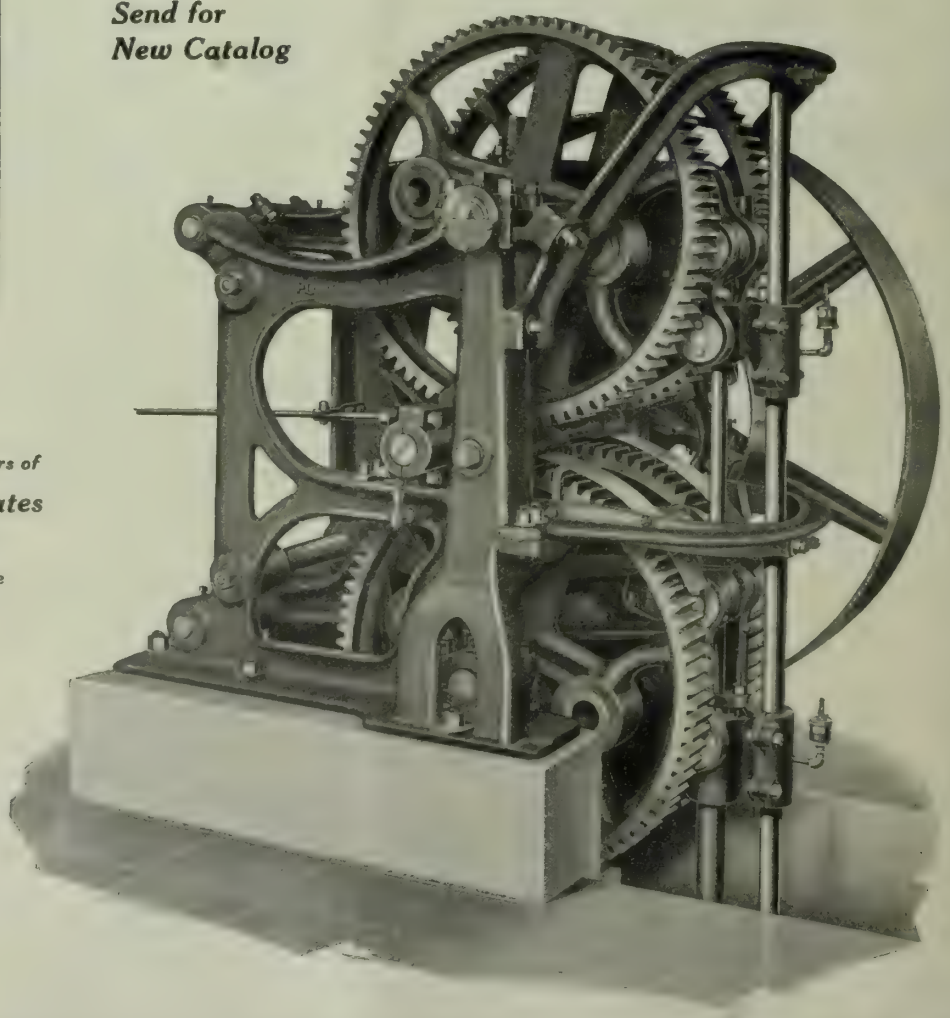

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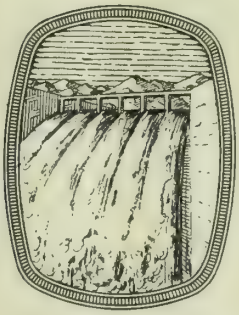
WILLIAM MARION JARDINE, LL. D.

Who became the head of the United States Department of Agriculture in March, and who is now making an extended tour of the far west, becoming more familiar at first hand with the special problems of irrigated agriculture. Dr. Jardine spent most of his early life in Idaho and Montana, and understands fully the importance of irrigation to American agriculture. As the result of his present contact with the men and problems of the irrigation country, it is expected that his department will adopt an aggressive program for the furtherance of sound irrigation policies.

MODERN Irrigation

The Magazine of Applied Hydraulics



Volume 1 JULY, 1925 Number 1

A Voice for Irrigation

THIS new journal, dedicated to the interests of those who are serving America by pushing her boundaries outward, increasing her wealth, harnessing her natural resources and putting them to the service of her ever-growing population, through irrigation, is brought into being by the demand of circumstances.

The Great West stands in an eventful hour. Its history has been a record of prodigal exploitation. It offered to the early pioneers a vast new empire, with a horizon of staggering sweep, and resources apparently limitless in extent. But it required only a few decades for the appropriation of the riches most easily grasped; then started the era of agricultural development. Fertile acres, ready to yield in abundance, were apparently plentiful, requiring but the most casual care to return enormous crops. These too, however, soon disappeared; the westward trend of population and the demand for increased efficiency made the returns of unwatered areas inadequate.

But the magic of water was called to the task; and by this marvelous force the lands already under cultivation were made a hundred-fold more productive; while millions upon millions of acres which had been the undisputed realm of the cactus and the coyote were transformed into flowering garden spots. The supply of land which could be thus brought into use appeared measureless, and apparently in the everlasting snows and the turbulent streams which they fed there was water enough and to spare.

So, from stage to stage, the west has gone, confident that its wealth was inexhaustible, and the future amply provided for in the beneficent bequests of nature.

But now, in the second quarter of the twentieth century, for the first time, that assumption is being questioned and refuted. The cream has been skimmed; the remainder, rich enough in all truth, is for the first time being used with something like a realization that there is not an infinite supply. Already, where the ingress of population has been most rapid, and the development of land and the appropriation of water most intensive, those most concerned, at least, are recognizing that the problem of imminent exhaustion actually confronts them.

California, where irrigation has furthest progressed, is facing a condition recently expressed in these words: *"Much of California's agricultural lands have less water in their vicinity than is required*

by them for maximum productivity, and . . . . the total supply, even with complete conservation, is barely adequate to meet the state's potential demands for water."

IN OTHER parts of the United States where irrigation is extensively employed, comparable questionings are causing grave concern to those who have developed their water supply with blind confidence that its limit would never be reached. In other states, not so far removed from the primeval condition, and just entering (comparatively speaking) the era from which California is now emerging, these doubts have not yet been generally felt—an appreciation of the true condition exists only in the minds of an informed minority of their technical men. But the realization is coming, wherever irrigation is employed, and that at a time not far off.

With this recognition of the grave problems attendant upon irrigation and its allied fields of industry, there come new needs, never before encountered. Where unco-ordinated and disorganized development has served in the past, the present demands co-ordinated action in accordance with a dominant plan which recognizes the needs of tomorrow as well as of today. Communities in need of water find themselves unable to satisfy that need by a random appropriation of the nearest stream; their desires and interests come in conflict with those of other communities, and the result is inharmony, antagonism, and a delay for needed progress. Whole states find themselves at variance over the proper disposition of their vital resources, and there is no guiding voice to point the way to an equitable settlement; no proper authority to enforce it.

Correspondingly, there is coming a tardy recognition of the inter-dependence of all the problems dealing with the exploitation of the land. Land settlement boards, flood control commissions, irrigation projects, domestic water companies, hydro-electric interests, and various other agencies for the management of drainage, reclamation, conservation and for kindred objects have been doing their work under different heads, along different lines, and often at cross-purposes, with an inadequate realization of the fact that they represented merely different phases of the one great purpose. A clearing house for the activities of these instrumentalities, which might serve to relate and consolidate their achievements, has been a vital lack.

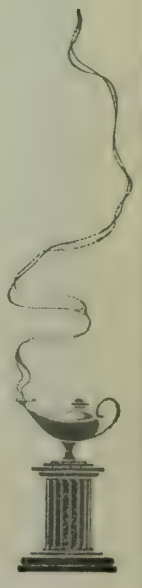
On the other hand, with the increasing utilization of available water resources, the problem of the consumer or "water user" has been made a more difficult one, involving highly complex economic and technical factors. There has been much admirable educational work done by various agricultural organizations to help the farmer in the solution of his problems as a user of water, but it has been incomplete.

These tremendous movements all point toward one great conclusion—*the need for a Voice.* Irrigation needs a voice—not the voice of any single, self-concerned interest, for there are many of these, each shouting aloud and trying its best to drown out those which are not declaiming the same message and gospel; not the voice of a political organization, circumscribed by political considerations and statutory limitations; not the voice of the man with a panacea, who would force his plan down the reluctant throats of all irrigationists. But the voice of a sincere, serious, plain-spoken tribune, unsubsidized, unwedded to any particular plan or theory, eager only to present to all those interested in water problems the best that can be gathered together from the multifarious fronts on which the army of Irrigation—and its kindred hydro-industrial enterprises—is active.

IN relation to all these problems, the element whose welfare is most vitally involved—the public—is silent, apathetic, ignorant. The engineers may point out the need for far-seeing vision; the wiser legislators may attempt to further the progress of irrigation through sensible laws; but the public remains content either to let the future of its most important physical possessions, its soil and water resources, be determined by those whose concerns are not generally unselfish; or, worse, allows its resources to be dissipated, often times destroyed, through the lack of proper conservation measures, without lifting even a feeble voice in protest.

These are the circumstances, and these the considerations, which have demanded, with an insistent call that can not be resisted, the establishment of such a magazine as MODERN IRRIGATION.

This journal is not launched with the idea that it can provide a ready answer to the myriad riddles which surround the present status of irrigation affairs, or direct its future with infallible wisdom. On the contrary, it begins publication with a keen appreciation of the great immensity of its field and the necessary insignificance of any single element, realizing that such an enterprise must, by a gradual process and by prestige well earned, extend its sphere of influence in increasing circles until by its own accomplishments, and with the whole-hearted cooperation of every agency working for the same desired ends, it deserves to be regarded as an authoritative spokesman.



If Irrigation has been dumb for the lack of a Voice in the past, it will not become at once eloquent because of the establishment of this journal, but it is our hope and aspiration that MODERN IRRIGATION may, from the very beginning, form some syllables of its great message in intelligible, constructive form; and, with the passage of time, may become a strong, clear voice of wisdom, speaking as one having authority.

IN THE conception of this enterprise and the execution of its first steps, the publishers have been content to proceed slowly. The idea of MODERN IRRIGATION has been developing for years. The experience of its publishers in the field of industrial journalism had shown them both the need and the opportunity for a class magazine dedicated, primarily, to the service of the irrigation industry, the fundamental basis of the West's present and future prosperity. Actual work on the enterprise was begun more than a year ago, when the publishers began a series of conferences with influential and representative men vitally concerned with irrigation, whose positions are such that they can recognize the need for such a magazine as this.

The conferences with these leaders of irrigation manufacturing, irrigation finance, irrigation management, irrigation engineering and irrigated agriculture have led, by a natural process, to the formation of a Board of Editorial Advisors, comprised by these leading figures of the industry who have promised to give their interest and thought to the guidance of the magazine along the most useful lines. None of these men are serving for compensation; none of them are personally interested, directly, or indirectly, in the financial success of the magazine; their participation in its direction is merely a manifestation of their vital concern in the advancement of irrigation. Their advice and counsel will be proffered, often at a sacrifice of their own leisure time, in an effort to make MODERN IRRIGATION of maximum usefulness to the irrigation and reclamation movement.

These Advisors represent no one faction, no "interest," no particular division of the industry or section of the country. But they do, in the aggregate, represent a gratifying evidence of the instantaneous response which MODERN IRRIGATION has elicited from the far-seeing men in all the divisions of the irrigation world.

As to the future performance and value of the new magazine, we are content to let our columns speak for themselves. Pledges mean nothing, and promises are empty, unless they are tangibly supported in actual accomplishment. But of this we are convinced—the opportunity is present for genuine service, limited only by our own capacity for accepting it. And this we know—that our intention is to seize that opportunity and make our journal an outstanding force for the advancement of this, the West's greatest industry—hence of *all* industry throughout the West. Our success will better be judged by our readers than by ourselves, as it is manifest in succeeding issues.

There are great controversial questions shaking the world of irrigation today; there are policies which are undergoing radical transformations; there are conceptions which are being made over and reshaped as theory is met and overcome by experience. In questions of this kind, our purpose will be to contract no alliances with factional groups, to espouse no disputed doctrines—rather to help in finding the wise course of action by avoiding preconceived ideas and controversial affiliations, and to search for the truth as it may appear.

OUR ideal for our magazine will be unsatisfied unless, in each issue, there shall be something of practical and vital value for every one whose interest lies in irrigation, or who, in the allied hydraulic fields, will find the magazine of an equally practical service to them. Our purpose will be to select our editorial contents on such a basis that the smaller water user, who is concerned with bringing water to his land at the smallest cost and greatest efficiency, will find help in earning a better living and in growing better crops; the large irrigator will find suggestions that he may put into practice in solving the problems of managing his more extensive activities; the engineer will encounter new ideas which will add to his store of information and his skill in coping with the technical aspects of the industry; the executives of the irrigation district and the irrigation project will read of the experiences of other managers and find new inspiration and new help for their tasks—and so on, through the list.

And through the composite contents of the magazine, a great industry, a great constructive movement, may speak, not only to its own members, carrying on the work of subduing nature and of bending its forces to the service of mankind in many parts of the world, but, through the endless circles of influence set in motion, to the man in the street, in such a tone and with such an attention-commanding message that he will pause, and listen; and the vast, far-flung forces of the industry, which are faithfully working in his service, will at last have found an articulate Voice.

A. C. HARDISON

C. C. TEAGUE

J. V. MENDENHALL

Who comprise the present membership of the Agricultural Group of MODERN IRRIGATION'S *Board of Editorial Advisors*

Leaders of the Irrigation Industry Will Serve as Advisors to *Modern Irrigation*

By DOUGLAS G. McPHEE

NEVER was an infant ushered into the world under more favorable auspices than the baby MODERN IRRIGATION. Never did a more auspicious group of god-fathers welcome its coming, and scan with attentive interest each of its salient features. Thirty prominent westerners — men whose names are familiar wherever irrigation is practiced, and whose titles stand for constructive usefulness in the irrigation world—will read with heightened interest this introductory number of MODERN IRRIGATION; because they are, in a sense, its god-fathers, members of its Board of Editorial Advisors.

These men have endorsed the plans and purposes of the new magazine, as they have been set forth by its publishers, and without personal concern in its success except as they are interested in the advancement of the entire irrigation movement, have pledged to it their support and their personal co-operation.

This group of men includes the recognized leaders of the several lines of endeavor most intimately related to irrigation—agriculture, industry, education, law, finance, conservation and engineering. Most of them are known throughout the entire irrigation industry; many of them are national or international figures.

GEORGE C. PARDEE
Conservation Group

It is these men who will help to guide the publication in the course of maximum usefulness to the field which it will serve; and it is their willingness, acting without compensation or concern in the business success of the venture, to participate in its direction, that constitutes its greatest endorsement to is readers.

IF a magazine, like a man, may be judged by the company it keeps, MODERN IRRIGATION begins its career deserving of the most favorable judgment. For probably never before in the western irrigation industry has a single group been organized to include, within its personnel, so many of the acknowledged leaders of the agricultural, industrial and professional life of the West as those activities touch upon irrigation.

The entire Board of Advisors has not yet been completed, for it is the intention of MODERN IRRIGATION to make it representative of not only each separate line of work with which irrigation is in constant contact, but of each geographical section of the irrigation empire. The membership will shortly be completed by adding men from each western and mid-western state occupying commanding places in the irrigation activities of their section, and other men in each of the main groups represented in the present membership who have not yet been approached, but whose prominence in the industry is such that their co-operation would be decidedly helpful.

THE formation of the Board of Editorial Advisors is a part of the general plan upon which MODERN IRRIGATION has been launched—a vital part of which is to make this publication not only an organ *for* the irrigation industry, but *by* the irrigation industry, with its policies and program dictated by the actual needs of irrigationists and irrigators.

That the leaders of the industry are sincerely and unselfishly interested in contributing their due part toward the welfare of the whole irrigation movement, without thought of direct personal gain, has been conclusively demonstrated by their willingness to serve as members of this Board. The publishers, in explaining their enterprise and asking for the co-operation of these men, expected to have to "sell" the idea by pointing out, in much detail, the great field and need for the publication. But in this they were most agreeably disappointed. In every case the individual approached, from his position of familiarity with the needs of irrigation, immediately recognized the potential value of such a publication, based upon the conservative and constructive principles outlined, and, having been satisfied that there was no "joker" concealed in the request for his endorsement, and his participation in its direction by counsel and advice, assented readily to lend his support in the guidance of its editorial policies.

THE nucleus of groups representing Agriculture, Engineering, Conservation, Land Settlement, Irrigation and Reclamation Law, Irrigation Management, Construction, Equipment and Research has been formed as a preliminary to the publication of the first issue, and each of these will later be completed by other outstanding authorities under the same classifications. To these will be added individuals representing the various sections of the west where irrigation is extensively practiced.

Each of these men has been carefully chosen as a representative of some particular aspect of irrigation, and each, by his experience or his official position—and in most cases both—has something definite to contribute toward making MODERN IRRIGATION a well rounded magazine of universal appeal.

M. B. PRATT
Conservation Group

PAUL G. REDINGTON
Conservation Group

The members of each of the groups comprising the Advisory Board will be introduced in coming numbers of the magazine. In this issue there is space to present only a few—the seven men who already have accepted membership on the Agricultural and Conservation Groups. They have been selected for this introductory number because they represent, in a sense, the basic and fundamental interests with which irrigation has to deal.

Three men comprise the membership (to date) of the agricultural group: Charles C. Teague, J. V. Mendenhall and A. C. Hardison.

Mr. Teague, as president of the California Fruit Growers' Exchange and the California Walnut Growers' Association, is a national figure in co-operative marketing, and has made a reputation for success in various private and corporate agricultural enterprises. He sums up the story of his relationship to irrigation by saying: "I came to California in 1893, and have been engaged in the development of lands, which development has primarily consisted of bringing water to the land and planting it to orchards." He is president of the following large agricultural and irrigation enterprises: Limoneira Company, Teague-McKevett Company, Farmers' Irrigation Company, Santa Paula Water Works, and the Thermal Belt Water Company, all of Santa Paula; the California Orchard Company, of King City, California, and vice-president of the Salinas Land Company, of King City. Mr. Teague's home is at Santa Paula.

FRANCIS CUTTLE
Conservation Group

J. V. Mendenhall is a native Californian whose interests have been intimately identified with the land for many years. He is president of California Delta Farms, Inc., the Holland Land Company, the California Approved Land Settlement Association, and the California Delta Potato Growers' Association. For three years he served as president of the California Bean Growers' Association. Mr. Mendenhall, through his various connections, is vitally interested in all phases of irrigation development, with especial concern in the great half-million acre area of the San Joaquin and Sacramento River deltas. His attitude toward irrigation is expressed tersely in his statement: "We all agree that the water question is the most vital and important question calling for solution in the west." Mr. Mendenhall lives in Stockton.

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Needs of Expanding Agriculture in America Call for New National Reclamation Policy

Oregon Senator Outlines and Explains Plan for New Legislation to Supplement Present Reclamation Act

By SENATOR CHARLES L. McNARY

Chairman, United States Senate Committee on Irrigation and Reclamation

RECLAMATION by irrigation has been practiced in the seventeen arid and semi-arid states since 1902. In all of these states there are large quantities of government owned lands untaxed and untaxable. In eleven of these states over 60 per cent of the land is owned by the national government. Realizing the great handicap these states suffered by reason of the large areas of untaxed lands, former President Roosevelt urged Congress to pass the original Reclamation Act.

The money necessary for this development was not taken from the Treasury of the United States but was created from a special fund accruing from natural resources within these states, such as royalties from oil and coal fields on the public domain, pasturage fees and charges, and a portion of the sales of public lands. This development work has involved the expenditure of 150 million dollars taken from this special fund. As a consequence of this expenditure, there are two million acres of land being supplied with water which were heretofore barren and unproductive, and which have added to the national wealth property values exceeding six hundred million dollars.

AS the country becomes more thickly settled and populated, and as we exhaust our available agricultural lands, there will be an ever increasing demand for the development of additional reclamation projects, many of which are vastly too large ever to be built out of the present reclamation fund, which has an annual increment of about eight million dollars. It is my opinion that this sum should not be diverted from the development of small and feasible projects in the states wherein there is a large area of government owned lands, and that the original act should be preserved in its full integrity. However, as the country increases in population, there will come a demand for the expansion of our agricultural area, and it is for that reason that I believe the government should establish a national reclamation policy.

This plan should include all forms of reclamation, applicable to the conditions in the various states of the Union. It may take the form of reclamation by the removal of water from the wet lands of the south, or conducting water to the dry lands of the intermountain and Pacific Coast states; the removal of stumps from the cutover lands in the Great Lakes states; the flooding of the lands in the Mississippi Valley states to provide for sub-soil irrigation, or the restoration of the soil in the New England states; indeed, every state would experience an increase in taxable wealth if some form of reclamation was practiced, provided there was a demand for the enlargement of farm production.

WHEN we consider reclamation by irrigation there come before us the important factors of flood control and the development of hydro-electric energy. A typical case is the proposed development of the Boulder Canyon in the Colorado River, where by the impounding of its waters a great amount of power can be developed at a cost that would seem to justify the venture. At the same time, the waters of the Colorado could be controlled in flood time so as to prevent the losses annually attendant upon the late spring freshets caused by the melting snow high in the mountains. In addition thereto, water can be supplied for thousands of acres of fertile lands in the Imperial Valley in California and those acres that lie across the border in Mexico. It is a worthy project that should be undertaken, even though perhaps the ultimate cost of the development would amount approximately to three hundred million dollars. The great Columbia River project lying in the far Northwest is similar in character. Many other potential developments could be specified in the various parts of the country.

WHEN the demand for increased agricultural acreage is keen and the necessity apparent, great drainage projects will be undertaken in the South, involving the expenditure of many millions of dollars. Likewise a call will be made for the clearing for cultivation of the cut-over lands along the Great Lake states. and the reclamation of soils in the New England and Atlantic states.

It is my humble judgment that Congress will not desire to take up these projects one by one, or two by two, by appropriation directly from the Treasury of the United States. Such a policy would encourage log rolling; it would incite jealousies among the advocates of the various projects desired to be developed, with the resultant effect that the whole scheme would fail by reason of the unscientific plan upon which it was based. The government needs a comprehensive and constructive policy of reclamation which can be invoked whenever the needs of an expanded agriculture occur. Legislation of this fashion must avoid the appearance of carrying federal aid to the point where it may be denominated a subsidy, and such a term could be applied if each of the various projects were to be constructed out of funds directly withdrawn from the Treasury.

IF Congress should enact legislation carefully protecting moneys advanced for this purpose, by exacting adequate security and assuring liquidity of the sums allocated among the various projects, the plan would not challenge the opposition of those unfavorable to Federal assistance. This legislative program would involve obtaining from the Federal Treasury a large sum of money approximating three hundred to five hundred million dollars to be advanced toward the construction of new projects found feasible by some department of the government. The individuals included within the development would have to incorporate themselves into a legally organized unit conformable to state statutes and agreeable to government requirements. The organization would be required by law to issue its bonds bearing the current rate of interest, and whensoever the project was a going concern and its soundness was attested by a proper agency of the government, the bonds would be sold to private investors

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MODERN IRRIGATION *wishes neither to endorse nor to disapprove Senator McNary's new reclamation measure, but presents this article for its informational interest.—Editor.*

THESE PICTURES MIGHT BE CAPTIONED "CAUSE AND EFFECT". WATER AND ELECTRICITY, THE COMBINATION SUGGESTED AT THE LEFT, MAKE CALIFORNIA A LAND OF FINE HOMES AND SPLENDID CROPS.

What *Electricity* is Doing for Irrigated Agriculture in California

By FREDERICK S. MYRTLE

Editor, Pacific Service Magazine

CALIFORNIA has developed the application of electrical energy on the farm to a greater extent than any other section in the country, if not in the entire world. Her position in this regard is due primarily to two factors: first, cheap and available hydro-electric power; second, the elaborate interconnected system of transmission lines, traversing every section of the great interior valleys which are the chief agricultural regions of the state.

California contains approximately one hundred and one million acres of land, of which the area considered to be suitable for cultivation is estimated at twenty-two million acres. Now, to properly cultivate these lands there must be water, and California with her wet and dry seasons has not, in her natural streams, the constant flow that gladdens the heart of the agriculturist during the five months of the year when irrigation is an absolute necessity. As a rule, from April to October of each year neither rain nor snow falls in California; so that when the supply of snow in the mountains is exhausted and runs off in the various streams to the ocean there is little or no water flowing into the main rivers.

Particularly is this true of those that irrigate the two main arteries of the state, namely, the Sacramento and San Joaquin valleys, save that which comes from storage and from underground springs. To the storage reservoirs, therefore, California looks for the supply that will keep flumes and ditches full during the arid months of the year when, without their help, thousands upon thousands of acres of farm and fruit lands would perish for want of life-giving sustenance. Those storage reservoirs are provided through the extensive development of hydro-electric power that has been in process since the first plant was established on the American River twenty-nine years ago, and which is progressing today at an almost feverish rate to meet the demands of a fast growing civilization.

From those storage reservoirs run flumes and ditches that irrigate fruit and farm lands alike, while that most wonderful of appliances to which, more than anything else perhaps, the farmer owes his present day prosperity,—namely, the electric pump—has proved a veritable benefactor in the work of both irrigation and reclamation.

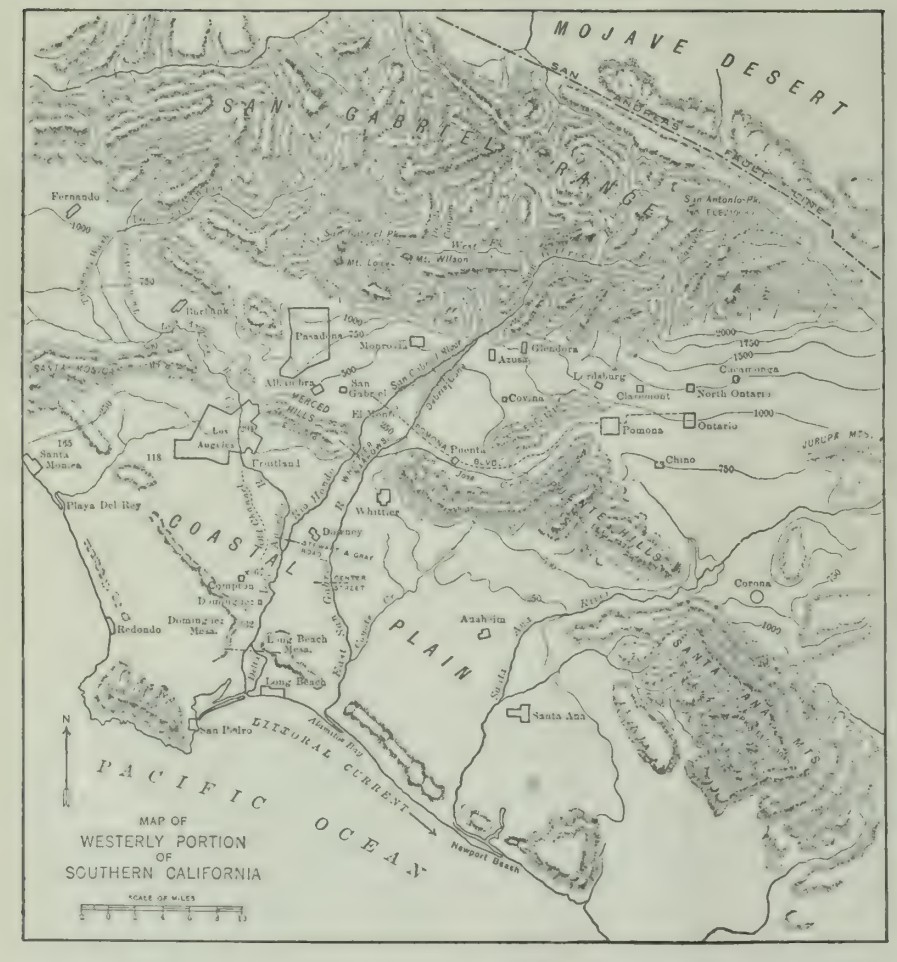
IRRIGATION has been aptly described as "crop insurance." Applied to conditions in California the description fits like a glove. From end to end of the Golden State there are long sweeping valleys of astonishing fertility that call for but intelligent cultivation to yield returns in boundless abundance. Modern science has pointed the way to intelligent cultivation and, given protection against Dame Nature's eccentricities, the California farmer can go his way contented. His protection, then, lies in irrigation in the arid sections and in reclamation in certain other sections of the country where the water supply promises to be too abundant at certain seasons of the year.

Irrigation is not a new thing; neither is reclamation; but both sources of prosperity to the tiller of the soil in California were, to all practical purposes, uncertain quantities until that great upbuilder, that greatest of all developers, cheap electric power, was made available, and the legend, "electricity on the farm," came to be generally inscribed on the banner of interior development.

It should not be necessary to remind the reader that the use of hydro-electric power generated in the Sierra Nevada Mountains and transmitted through the interior valleys to the large cities has had a marked influence on the varied industries that give California her place of prominence among the progressive states of the Union. Hydro-electric power has had the effect of creating new industries that, from an economic standpoint, were not possible before its introduction; and it has given a stimulus to other industries that were languishing even unto the point of death before this great public benefactor came to their rescue. Electric power has rejuvenated the mining industry; it has dotted the landscape of the interior with factories; it has helped extract the precious gold from the river beds; it has made the cement industry a most important factor in the state's development; it has solved the domestic problem to the point of positive luxury. But, if there is one thing more than another it has done to confer an everlasting boon and a blessing, it is the assistance it has given the farmer in his daily occupation and the protection it has afforded aganst the elements of risk that in early times made farming an extremely hazardous occupation.

In a section of the country where Dame Nature provides an average of three hundred days of sunshine out of every year it is indeed an advantage for the

(*Continued on Page 26*)



THIS MAP OF THE VALLEY OF SOUTHERN CALIFORNIA ILLUSTRATES MANY OF THE POINTS OF WHICH MR. SONDEREGGER HAS WRITTEN.

A Discussion of the Water Problems of the Valley of Southern California

By A. L. SONDEREGGER

THE VALLEY of Southern California faces water problems which are somewhat unique. The territory included in this term—which is here defined as all of Los Angeles, San Bernardino, Riverside and Orange counties—takes in not only the metropolitan area of the city of Los Angeles, one of the largest and most rapidly growing municipalities of the United States, but also some of the richest agricultural territory in the world. It embraces the watersheds of the Los Angeles, San Gabriel, and Santa Ana Rivers.

Commercially, this area is a unit, and is being increasingly so recognized. From the standpoint of its ultimate water supply it is no less a unit, and its problems must be so treated.

The chief factors affecting the water problem are:

(1) An irregular water supply with cycles of pronounced wet and dry periods in which the average supply differs about 3 to 1, and with a large portion of the flood flow wasting into the ocean;

(2) A marked shortage of supply, which would exist even if it were feasible to conserve all run-off and regulate the same to a cyclic average; this shortage is proposed to be supplemented from the Colorado River as the only available source;

(3) The necessity for large storage to regulate the irregular local supply, and any supplementary imported supply, to a heterogenous irregular demand which varies with the seasons of the year and with the relative wetness of wet and dry years.

THE water problem of this area resolves itself, therefore, into one of conservation of flood waste, in connection with flood control (to be solved individually for each principal watershed), and the importation of a supplementary supply to be considered for the Valley of Southern California as a unit.

These two problems are correlated and serve the same end.

It is accepted by many engineers that there are well defined cycles of 22 to 23 years consisting of periods of wet and dry years; 10 to 12 years in which the average rainfall and water supply is above normal, followed by a like period in which it falls below normal. The theory is based upon the results of the residual mass curve of rainfall and streamflow which, in turn, rests upon the fact that nature adapts itself to averages, accumulating moisture over a period of years and drawing on the same in the period following; otherwise the country would as one might say, either "dry up" or "drown."

The occurrence of periodical fluctuations of water supply has been proved by the Carnegie Institute, for 300 to 500 years back, from the rings of California Redwoods and from pines at Flagstaff and Prescott, Arizona. The periods average 11.4 years and follow closely the occurrence of sunspots.

The averages of the seasonal run-off of San Gabriel and Santa Ana Rivers for the various periods are an indication of general water supply conditions, to-wit:

AVERAGE SEASONAL RUN-OFF—From STATE BULLETIN NO. 5

PERIOD	INDEX	San Gabriel River Watershed Acre Feet	Santa Ana River Watershed Acre Feet
1871-1883	Dry	116,700	226,400
1883-1893	Wet	234,200	334,000
1893-1904	Dry	61,600	159,000
1904-1916	Wet	206,200	317,000
1916-1927	Dry (Incomplete)	103,000	231,800
Wettest year	1883-84	720,500	553,400
Dryest year	1898-99	9,700	66,200

This table indicates a less imperfect regulation between wet and dry periods in the eastern watershed of Southern California, on account of more snowfall and the existence of flats at elevations of 6,000 to 8,000 feet, for which both the San Bernardino and the San Jacinto

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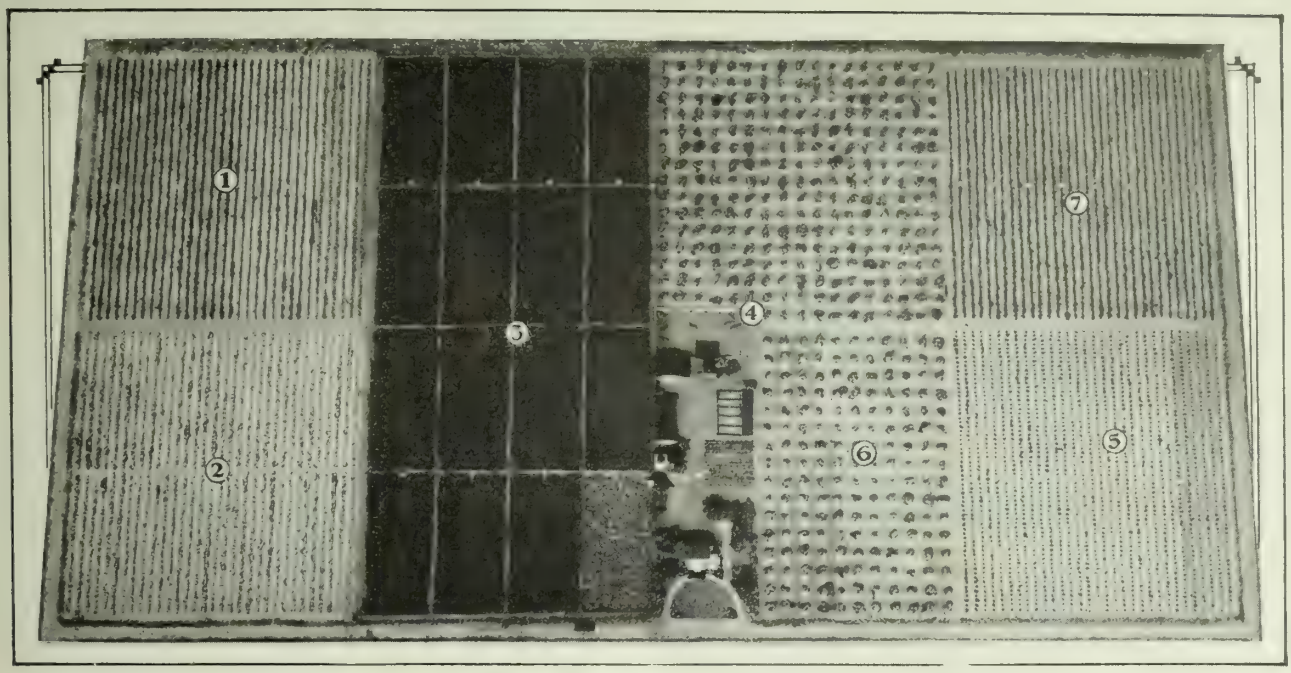

THIS EIGHTY-ACRE FARM IS ONLY EIGHT FEET LONG. ITS PROPRIETOR, SNOOK O'BRIEN, LEADS A MODEL LIFE AMID HIS DIVERSIFIED CROPS, COWS AND CHICKENS, ALL OF WHICH MAY BE SEEN IN THE PICTURE.

Model Electrified Ranch Tells Graphic Story of *Power Costs* on the Farm

SNOOK O'BRIEN is an irrigation farmer. He has gone through the experiences which are the common lot of the irrigation brotherhood, he has suffered all the ills that such flesh is heir to; yet he has persisted in his calling, and has achieved success.

Snook O'Brien's farm, and his products—even the cost of each element which enters into his expenses—are well known among the irrigationists of the west. He lives in a modern home in the middle of his modest acres, and is never seen by his neighbors; but the statistics of his enterprise, his profits and losses, have been noted and analyzed by scores of his brothers in the irrigation industry.

Snook's little farm is eight feet long, and four feet wide. His beautiful little home, thoroughly electrified with the most modern appliances, never echoes to the tread of feet across the threshold, for it is only of vest pocket size. And the reason that Snook himself, although so well known, is never seen engaged in tilling his land, or enjoying the well-won fruits of his labor under his vine and fig-tree is that Snook is a purely imaginary individual—or, rather, not imaginary, but a composite individual, representing the average irrigation farmer of a certain section of the west.

His farm is not merely a model farm in the sense that it is fully equipped with everything that the irrigator needs, electrified for convenience and efficiency from one end to the other, but it is a model, as well, in the Websterian sense of "a small imitation."

ON A table at the convention of the National Electric Light Association, being held this month in San Francisco, Snook O'Brien's farmstead may be seen and examined. It is offered as the contribution to the National Committee on the Relation of Electricity to Agriculture, by the Power Bureau of the Commercial Section, Pacific Coast Electrical Association. The display was largely worked out under the direction of A. M. Frost, manager of Sales of the San Joaquin Light and Power Company of Fresno, Calif.

"A great many of us," says Mr. Frost, who is chairman of the Commercial Section of the Electrical association of the Pacific Coast, "have had the idea for a long time of a display showing in graphic detail the application of electricity to agriculture. We believed that in order properly to tell the story of the value of electric power in the operation of irrigation plants we should have the information available in such an attractive form that those seeing it would be forced, by the interest of the display, to consider and analyze the figures submitted.

"Mere statistics and tabulations are dry reading—they don't get read at all, usually—and the Snook O'Brien farm is an attempt to present the ideal, electrified, irrigated farm in a form that tells the definite facts of costs, but in such a way as to impress even the casual observer."

THE model farm idea is hardly a new one, according to Mr. Frost—it has indeed been used many times in relation to many different aspects of the farmers' problems, but it is probable that it has never before been worked out in such detail, susceptible to such practical application, as in the hypothetical farm of Snook O'Brien.

In the compilation of data for use in this display many members of the Commercial Section have been active, and the Agriculture Committee of the Power Bureau has taken the matter up as one of its special activities.

Snook O'Brien's farm is an eighty-acre enterprise, devoted to diversified crops, including alfalfa, grapes, apricots, peaches, cotton, potatoes, milo maize, truck garden stuff, chickens and cows. In the display itself are visible the statistical tables of operation and production costs, so analyzed as to prove of help to the largest possible number of irrigation farmers.

The statistics used were compiled from averages as found in the San

Joaquin Valley, California, by members of the organizations carrying on the work, with the co-operation of others interested in agricultural work from other branches of the power industry.

Much of the information is taken from the files of the San Joaquin Light and Power Corporation, which, over a long period of years, has been serving power for the irrigation of land in this valley, and now serves about half a million acres in the district.

THE values of the crops and the tonnage records, as shown in the display, have been carefully considered, and are felt to be conservative. The nature of the O'Brien farm, with its diversification of crops, may, of course, lead to a better cost record than would be possible on a one crop farm. Referring to this advantage, Mr. Frost declares:

"The very great desirability of diversified agriculture is well appreciated throughout the state, and such diversity will, naturally, have a tendency to improve the load factor of the irrigation plants installed, benefitting both the power company serving the load, and the agricultural consumer. The consumer—in this case our friend Snook O'Brien—is enabled by the diversity of crops to keep his installation running a great number of months during the year, and, as a consequence, he gets into the lower blocks of the agricultural rate. He is also enabled to install a smaller plant than if his land were all planted to one product, for the reason that the one-crop ranch would require irrigation during only certain months of the year, which would increase demand and lower, or reduce load factor."

The photograph on this page of the model farm is a reproduction which does not do the O'Brien ranch full justice. It does, however, give a suggestion of the completeness with which it has been worked out.

The photograph shows only the farm proper. In the display itself, the most important part of which is the data which it incorporates, the farm is surrounded by tables showing the yield, return, cost, and profit on each of the eight crops produced, and setting forth in detail the items entering into the cost of irrigation.

EACH of the crops is taken up in detail, and with the aggregate costs are included the expenses incidental to the operation of the home, which is equipped with electric lights, range, water heater, sewing machine, vacuum cleaner, flat-iron, washing machine, toaster, percolator, fan and refrigerating machine, operated at a total power cost of $144. No financial return is shown from this expenditure.

"Of course," says Mr. Frost, "we believe that there is a distinct financial return from a properly electrified home on the farm, but as no products are produced that can be sold, we can not include this value in our calculations of profit."

"It is assumed that the water is being pumped for this farm, under a total head of 40 feet, which is about the average condition in the San Joaquin Valley," explains Mr. Frost. "We are, however, in many cases, supplying service on heads in excess of 150 feet, with very satisfactory results. We find that for the year 1924, the average cost for water in the San Joaquin Valley, produced by electric power on this system, was $1.27 per acre-foot. On a certain group of plants, (eleven, in number), with an average total head of 156 feet, five acre-feet of water was delivered on the ground at a cost of $2.56 per acre-foot. We consider these things very remarkable."

BENEATH the farm, in the display, appears this explanation:

"Snook O'Brien's Diversified Electrical Farm, Somewhere in the San Joaquin Valley, Calif.

"A presentation of the relation existing between power cost and gross return on an electrified farm, with a thorough diversification of products. The power costs were arrived at by calculating the performance of all electrical equipment based on actual experience. Such assumptions as had to be made on load factor, were carefully governed by selecting averages also based on farm practice. The final cost was computed by applying the proper rate schedule to the consumption thus figured.

"The method used to arrive at gross returns for the alfalfa, raisins, grapes, apricots, peaches, cotton, potatoes and maize products, was to take a reasonable average production, based on farm records, and apply an average selling price derived from an analysis of past and current market reports.

"For the returns from dairy and poultry products, the production figures were based on the assumption that select, high producers were used only. It was thought that average producers would not be warranted; when maintained on the comparatively small scale contemplated."

The following data are given for each of the eight crops represented:

Field No. 1, 10 Acres
POTATOES AND MILO MAIZE

Average yield	5 Tons Potatoes
Average yield	1½ " Maize
Total yield	50 Tons Potatoes
Total yield	15 " Maize
Selling price	$ 25.00
	35.00
Total return	1775.00
Acre ft. of water applied per year	44.00
Power cost per acre foot	1.24
Power cost for water per acre per year	5.43
Total power cost per year	54.26
Per cent of total power cost to total return	3.10%

Field No. 2, 10 Acres
COTTON

Average yield	750 Lbs. Seed
	¾ Bales Cotton
Selling price	3¾ Tons Seed
	7½ Bales Cotton
Selling price	20c
Total return	$843.75
Acre feet of water applied per year	31.20
Power cost per acre foot	1.24
Power cost for water per acre per year	3.83
Total power cost per year	38.32
Per cent of total power cost to total return	4.50%

Field No. 3, 10 Acres
ALFALFA

Average yield	8 Tons
Total yield	160 Tons
Selling price	$ 15.00
Total return	2400.00
Acre feet of water applied per yr.	100.00
Power cost per acre foot	1.25
Power cost for water per acre per year	6.17
Total power cost per year	123.45
Per cent of total power cost to total return	5.10%

FARM YARD—3 Acres

10 Cows, 150 Hens, Vegetables and Truck Garden		
Total yearly yield	6280 Lbs. Butter Fat	
	3000 Doz. Eggs	
	$100 Garden Truck	
Selling price	Butter Fat 40c	
	Eggs 20c	
Total return	Butter Fat $2500.00	$3200.00
	Eggs 600.00	
	Garden Truck 100.00	
Acre feet of water applied per year		$ 7.50
Power cost per acre foot		1.24
Power cost for water per acre per year		3.05
Power cost for Milking Machines		53.03
Separator		
Sterilizer		
Feed Grinder		
Yard Lighting		
Total power cost per year		$62.19
Per cent of total power cost to total return		1.90%

Field No. 4, 10 Acres
PEACHES (Green) ORCHARD

Average yield	6 Tons
Total yield	60 Tons
Selling price	$ 35.00
Total return	2100.00
Acre feet of water applied per yr.	25.00
Power cost per acre foot	1.24
Power cost for water per acre per year	3.09
Total power cost per year	30.86
Per cent of total power cost to total return	1.60%

(*Continued on Page 24*)

THE EAST PARK DAM ON LITTLE STONY CREEK CONTROLS A RESERVOIR OF 51,000 ACRE - FEET CAPACITY.

What One *Successful* Reclamation Project Has Done--*Orland,* California

By R. C. E. WEBER

Superintendent, Bureau of Reclamation, Orland, California

THE Orland project, comprising about 20,600 acres of land, and constructed under the National Reclamation Act by the Bureau of Reclamation, is located in the north-central part of the Sacramento Valley, California, about 100 miles north of Sacramento.

The first steps looking toward the construction of this project were taken in 1906, when the Orland Unit Water Users' Association was organized, and a petition addressed to the Secretary of the Interior which led ultimately to the approval of the project and the beginning of construction.

The lands in this area were formerly devoted to raising grain crops — wheat and barley—but the soil had become impoverished to such an extent that grain could not profitably be produced except in alternate years. Before 1911, about 150 acres of land were under irrigation in and around the town of Orland from the unregulated flow of Stony Creek, which usually furnished a limited supply of water until the middle of June.

THE EAST PARK FEED CANAL, DIVERSION DAM AND HEADWORKS, ORLAND PROJECT.

A realization of the economic waste of such conditions led to the project's construction. It was begun in 1909 to include 14,000 acres, and in 1914 was extended to its present area.

The cost of the project, as completed, has been fixed at $55.00 per acre, repayable in 20 annual installments. Construction repayments began to accrue in 1916, and prior to 1924, eight installments of this charge, aggregating $14.96 per acre, had been paid in full on the due dates. As a result of a sixty per cent loss in crop production in 1924, when only one-fourth of the normal water supply was available on account of the abnormal deficiency in rainfall and the Stony Creek run-off, there was, for the first time in the history of the project, a delinquency in the payment of reclamation charges to the government.

Notwithstanding those adverse conditions, however, construction payments of more than one-half of the total amount due, together with a repayment of nearly three-fourths of the operation and maintenance charges for 1924 were made, and the outstanding amounts will be further reduced when returns from crops produced during 1925 are available.

The operation and maintenance charge on this project has varied from a maximum of $2.00 per acre in 1920 and 1921 to a minimum of $1.60 per acre—the rate established for the current year. The present installment of the construction charge amounts to $3.30 per acre per year. The earlier ones were at the rate of $1.10 and $2.20 per acre per year annually.

Statistical results of irrigation on the project appear in the table which accompanies this article.

With the completion of the storage works, water was first available for the entire season during 1911, when 2,663 acres were irrigated. With the exception of two years of abnormal drouth and consequent water supply shortage, there has been an expansion of the irrigated area each year until, at the present time, some 15,500 acres, or 75 per cent of the total project area, are being irrigate.

A STUDY of the reduction in crop production values in 1920 and 1924 as shown in this table (the result of water supply shortages) indicates that the present storage facilities of the project are not sufficient to furnish an adequate irrigation supply in years of less than normal rainfall. This has been recognized by both the Reclamation Bureau and the Orland water users and preliminary plans and estimates have been prepared and a tentative initial appropriation made by Congress towards the construction of a second reservoir on Stony Creek for the purpose of developing a storage holdover during years of normal rainfall and run-off for use in a possible succeeding drouth year.

While the cost of the contemplated work will exceed the original cost of the project, the Orland water users are willing to assume the increased charge on

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The EDITORIAL

MODERN Irrigation

An Organized Voice for the Forces of Agriculture and Industry Which are Primarily Dependent upon Irrigation.

Published Once a Month
AT LOS ANGELES, CALIFORNIA, BY THE PETROLEUM WORLD PUBLISHING CO. *Editorial and Executive Offices, 626 South Spring Street, Telephone Broadway 3262.* Branches: SAN FRANCISCO—447 SUTTER STREET, *Telephone Garfield 2772;* H. E. TAYLOR, *Manager.* CHICAGO—1163 MONADNOCK BLDG., *Telephone Wabash 8855;* JOSEPH E. O'CONNOR, *Manager.* NEW YORK—503 FIFTH AVENUE, ROOM 308, *Telephone Vanderbilt 8753;* WERNER HAUPTLI, *Manager.*

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Executive Editor

By Annual Subscription in the United States and possessions, $2.00; Foreign, $2.50; Single copies on sale in the irrigation country, 20 cents. In ordering change of address, give both the old and the new address. Allow ten days for re-entries on the subscription list. Advertising rates and circulation data upon request. Checks should be made payable to Petroleum World Publishing Co.

VOL. I JULY, 1925 NO. 1

How and Where We Stand

CONSIDERABLE space has been given in this first issue of MODERN IRRIGATION to an exposition of the ideas and policies behind the magazine. It is important that any new enterprise of this kind should identify itself clearly and distinctly, in making its initial approach to those whom it expects to serve. It is unnecessary, of course, to add that this is a characteristic of the introductory number only. In future issues less attention will be given to MODERN IRRIGATION the magazine, and more—much more, as time goes on—to *Modern Irrigation* as an economic force, the foundation of agriculture in the west; and the underlying basis of western progress and western prosperity; at once a science, a great movement and a far-flung industry.

Some confusion, perhaps, may be occasioned in the minds of readers by the fact that MODERN IRRIGATION is published by the Petroleum World Publishing Company. In order that such confusion may be at once dispelled, it should be explained that this company has for many years been the publisher of PETROLEUM WORLD, the leading trade journal of the western oil industry, and takes its corporate name from that magazine. The company is not financially connected with, or subsidized by, any oil company or by any other organization or individual, and maintains a policy of independence and fairness toward all the elements of that industry, to which fact may be ascribed much of its success.

The company's decision to issue MODERN IRRIGATION, entirely apart from its other publications, as a magazine dealing exclusively with the interests of the irrigation industry, has come as a result of the recognition that this field presents unequalled opportunities for service. Already well organized for the publication of high-class industrial magazines, and located in the state where irrigation is most widely practised, it has been a logical development for the company to launch this new enterprise.

In so doing it has no axe to grind, no private theories to exploit, no propaganda to implant. Its one ideal is to create a magazine which will be a really representative organ of irrigation, and a constructive force for the dissemination of valuable information among irrigators and water users of all classes.

The Modern Journal

FROM its experience in the publication of industrial journals, the company has developed a very definite theory as to the proper function of such an organ. This theory is based on the premise that without the confidence of its readers such an endeavor is fruitless. Proceeding upon this basis, it is the purpose of MODERN IRRIGATION first to gain that confidence; and it sees no other way to acquire it than to deserve it honestly.

The usefulness of that man or that publication is destroyed which permits itself to be known as the spokesman of any one particular group or interest. From the time of its identification as a "special pleader" all of its utterances will be discounted, and they ought to be. It is because of this conviction that MODERN IRRIGATION enters upon its career without one entangling alliance, without one pledge made or promise given to any faction or interest, with only one expressed intention—to help to convey the truth about irrigation in its most useful form.

The ambition of the magazine is to become known as a reliable and authentic source of information, both general and technical, on all phases of irrigation and applied hydraulics. An especial effort will be made to present technical articles, which will be valued for their intensive interest to particular elements of the industry, along with general articles of an inclusive and extensive appeal to irrigators and technicians everywhere.

The Editorial Function

THERE was a time in the history of journalism when this sort of a policy was not the usual attitude of the editorial mind. In the "good old days" of Dana and Greeley, or perhaps as recently as the era of Marse Henry Watterson, the editorial function was that of a St. George, riding forth to slay

POINT *Of* VIEW

the dragons of ignorance or wilful opposition, armed with a pen that was tipped with triple brass. The editor was more than a mere collator and interpreter—he was a fierce and fiery tribune, cheered on by those who agreed with him, and riding rough-shod over the tender toes of all who did not. He sat in his editorial office, glaring at the world and condemning all his opponents to torture upon the pillory of his vitriolic vocabulary.

That policy, however, was better suited to a more primitive day and to a less complicated field of writing than to modern industrial journalism, in which no one—least of all a mere editor—may pose as the embodiment of all knowledge.

It is the conviction of MODERN IRRIGATION that the men who are actually working out the problems of the industry, thoughtfully, sincerely, and with an ideal of unselfish service, are the ones who are eminently qualified to supply the solution to its problems. The editor may better be a hard-working, prosaic interpreter of opinions and events than a picturesque Don Quixote astride the steed of dogmatic argument. And it is on this basis, and in line with these ideals, that the magazine is dedicated and presented to its readers.

A Titanic Task

BEWILDERING in magnitude is the field which MODERN IRRIGATION faces and the task which it has set for itself. The mere geography of the irrigation empire is an amazing thing—millions of acres of land, in hundreds of valleys, waiting but for the coming of water to spring into fruition; thousands of rivers, great and small, winding their way from the eternal snows and needing but the skill of the engineer and the judgment of the financier to transform them into fountains of wealth.

And the ramifications of the industry are so many! "How far back do you intend to take this matter of irrigation?" asked a notable figure in western agriculture, in speaking to the editor concerning the projected magazine. "Are you going back to the very beginning? If you are, you ought to include in your field those pressing problems of conservation and re-forestation which challenge every irrigationist who has the vision to comprehend them; and who considers not only the conditions of today, but their relation to tomorrow's water-supply."

Yes, it is an immense and a challenging field. Upon irrigation more depends, by far, than the solution of the problem of some few communities, that foresee, in the appropriation of water, the chance for their own expansion. The swelling population of America looks toward the west, and the west looks toward irrigation for the answer to the riddle of the future.

A Goal to Strive for

BUT it is easy enough to generalize and to voice eloquent platitudes about the subect. The real task of this publication will be to put form and substance into the vision, once caught, and bring forth an instrument of widespread service to each institution, and to the individual, in the irrigation field, in order that they may meet successfully the problems which confront them, and, at the same time, advance the welfare of the industry as a whole.

That is the goal which we will strive for. Too much, perhaps, to expect to accomplish between the covers of a magazine, issued but twelve times a year, and directed by mere human beings. But an ambition worthy of any one's effort. With the help of those who have pledged their co-operation to MODERN IRRIGATION, we face the task ahead with every confidence as to what the ultimate result will be.

Irrigation Needs Recognition

THE fact that no such journal as MODERN IRRIGATION has ever been launched, on a scale proportioned to the immense field of the industry, is but one further suggestion (of which there are so many for the thoughtful man to ponder) that irrigation is not recognized throughout the west at its true value. It seems strange, indeed, that this great force is so largely "taken for granted" by states which, without it, would be reduced to the status of semi-arid wastes upon which agriculture might be possible, but not profitable.

Charles C. Teague, probably the best known grower of citrus fruits in the west, said to the editor recently: "I could not afford to own and operate a farm that was not under irrigation." This is increasingly the attitude of practical horticulturists, who have learned the value of an adequate water supply in the school of stern experience.

And if this be true, what must be said of the state, or of the nation, that neglects or refuses to realize the paramount importance of irrigation and all things connected with it?

ANOTHER prominent irrigationist—F. A. Reid, president of the Salt River Valley (Arizona) Water Users' Association—was speaking recently of the general lack of appreciation of irrigation's importance. Mr. Reid said: "There are hundreds of thousands of people in the west, especially in the large cities, who go their way with no idea that irrigation means anything, at all, *to them;* and all the while their very livelihood depends upon the continuance and improvement of the irrigation systems of the semi-arid states."

The job of bringing home to the irrigator himself the magnitude of his responsibility, equipping him to meet that responsibility more fully, and of obtaining general recognition for the industry, can not be accomplished in one month, or one year, or by any one organization. But it must be done. MODERN IRRIGATION believes that it can help to do it.

The Snook O'Brien Model Farm

(*Continued from Page 20*)

Field No. 5, 10 Acres

MALAGA GRAPE VINEYARD

Average yield	6 Tons
Total yield	60 Tons
Selling price	$ 40.00
Total return	2400.00
Acre feet of water applied per yr...	25.00
Power cost per acre foot	1.24
Power cost for water per acre per year	3.09
Total power cost per year	30.86
Per cent of total power cost to total return	1.30%

Field No. 6, 10 Acres

APRICOT (Dried) ORCHARD

Average yield	1¼ Tons
Total yield	8¾ Tons
Selling price	$ 200.00
Total return	1750.00
Acre feet of water applied per yr...	17.50
Power cost per acre foot	1.24
Power cost for water per acre per year	3.05
Total power cost per year	21.37
Per cent of total power cost to total return	1.20%

Field No. 7, 10 Acres

THOMPSON RAISIN VINEYARD

Average yield	1½ Tons
Total yield	15 Tons
Selling price	$ 80.00
Total return	1200.00
Acre feet of water applied per yr...	25.00
Power cost per acre foot	1.24
Power cost for water per acre per year	3.09
Total power cost per year	30.86
Per cent of total power cost to total return	2.60%

In conclusion, a recapitulation of the relation of power cost to gross earnings, and a table of water duty for each crop by months, are given. These appear herewith in tabulated form.

RELATION OF POWER COST TO GROSS EARNINGS

(Recapitulation)

Product	Total Gross Return	Total Power Cost	% of T. P. C. T. G. R.
Alfalfa	$ 2,400.00	$123.45	5.1%
Thompsons-Raisins	1,200.00	30.86	2.6%
Malagas-Raisins	2,400.00	30.86	1.3%
Apricots-Dry	1,750.00	21.37	1.2%
Peaches-Green	2,100.00	30.86	1.5%
Cotton	843.75	38.32	4.5%
Potatoes & Milo Maize	1,775.00	54.26	3.1%
Cows, Chickens & Garden	3,200.00	62.19	1.9%
The Farmhouse		144.00	
Total	$15,668.75	$536.17	3.4%

SNOOK O'BRIEN'S TABLE OF WATER DUTY

Showing Acre Ft. of Water Applied

Table of Water Duty and distribution. Equipment consists of 10 H. P. Motor and 5-inch pump; delivers 550 G. P. M. at 40 ft. head—2.2 acre ft. per day—25 per cent loss allowance to cover evaporation and seepage.

Months	Alfalfa 20 A	Thompsons 10 A	Malagas 10 A	Apricots 7 A	Peaches 10 A	Potatoes Cotton 10 A	2nd Milo Maize 10 A	Truck Garden House & Barn 3 A	Total
March						16.00	6.30	.50	22.80
April	8.30	6.25	6.25				6.30	.50	27.60
May	16.70	6.25	6.25	4.38	6.25			.75	40.58
June	8.30	6.25	6.25	4.38	6.25	8.00	12.50	.75	52.68
July	16.70	6.25	6.25	4.37	6.25	3.60	6.30	.75	50.47
August	8.30			4.37	6.25	3.60	6.30	.75	29.57
September	16.70							.75	17.45
October	8.30							.75	9.05
November	16.70							.50	17.20
December								.50	.50
January								.50	.50
February							6.30	.50	6.80
Total per year	100.00	25.00	25.00	17.50	25.00	31.20	44.00	7.50	275.20
No. Days Irrigated	45.45	11.37	11.37	7.95	11.37	14.18	20.00	3.41	125.09
No. Hours Irrigated	1090.80	272.76	272.76	190.92	272.76	340.32	4.08	81.84	3,002.16
No. KWH Consumed	9817.20	2454.34	2454.34	1718.28	2454.34	3062.88	43.20	736.56	27,019.44
% of Oper & Pr. Cost	36.4%	9.1%	9.1%	6.3%	9.1%	11.3%	16.0%	2.7%	100%
Proportion of Pr. Cost	123.45	30.86	30.86	21.37	30.86	38.32	54.26	9.16	339.14
Pr. cost per A ft. pumped	1.24	1.24	1.24	1.24	1.24	1.24	1.24	1.24	1.24
Pr. cost per A per year	6.17	3.09	3.09	3.05	3.09	3.83	5.43	3.05	4.24

Modern Irrigation's Advisory Board

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Allan C. Hardison is president of the California Farm Bureau Federation and a member of the executive committee of the American Farm Bureau Federation. In addition to his prominence in farm-bureau work he is a successful horticulturist and an engineer of note. He is president of the Hardison Ranch Company, and officially identified with a large number of citrus associations and kindred organizations. He is president of the San Cayetano Mutual Water Company and vice-president of the Santa Paula Water Works, Thermal Belt Water Company, and Farmers' Irrigation Company, all of which are Ventura County (California) organizations. Mr. Hardison has rendered conspicuous service also in the field of agricultural education, having been a member of a commission appointed by former Governor Stephens of California to make a national survey of agricultural colleges with a view to improving methods of instruction in the college of agriculture of the University of California.

Four men have been invited to join and have accepted membership on the conservation group. They are George C. Pardee, Francis Cuttle, Paul G. Redington and M. B. Pratt.

Dr. George C. Pardee was an eminent surgical specialist before he was called to distinguished public service by the people of California. In 1891 he was chosen mayor of the city of Oakland, and was successively a regent of the state university and Governor of the state. His activities include important service in the interests of conservation; he was formerly a member of the National Conservation Commission, served as chairman of the California Conservation Commission, and is now chairman of the California State Forestry Commission. He is still active in business as president of the East Bay Municipal Utilities District at the age of sixty-eight, and interested in irrigation in all of its aspects. His home is in Oakland.

Francis Cuttle, for the past twenty-two years, has been president of the Riverside Water Company and prior to that, for sixteen years, was its superintendent. He has been president, also, of the Water Conservation Association, formed to conserve and utilize the waters of the Santa Ana River and its tributaries, since its inception in 1909, and has served as chairman of the Tri-Counties Reforestation Committees since it was organized by San Bernardino, Riverside and Orange counties in 1907 for a similar purpose, with a comprehensive plan of conservation, reclamation and flood-con-

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THE IRRIGATION DIGEST

A Monthly Bulletin Board of Brief Facts and Events from the World-Wide Field

VALE, OREGON.—A survey of the Vale project has been begun, preliminary to the beginning of actual construction work, by R. J. Newell and T. A. Clark, government engineers of Boise, Idaho.

RIVERSIDE, CALIF.—The Riverside Water Company, by amendment of its by-laws, has become a mutual water company, and will supply water to its stockholders only.

SPOKANE, WASH.—The fourth annual convention of the Columbia Basin Irrigation League will be held here on July first, with Secretary Work and Commissioner Elwood Mead in attendance.

LAS VEGAS, NEVADA.—The Las Vegas Chamber of Commerce is fostering the formation of an irrigation district to take care of the rising water table in certain portions of the Las Vegas Valley. The water, which will be developed by means of drains, will be used on lands below Las Vegas.

WASHINGTON, D. C.—Estimates of the gross income from American agricultural products during the year 1924-25 indicate a material increase over the previous year. The current crop-year is expected to show a gross income of approximately twelve billion dollars, compared with $11,500,000,000 in 1923-24.

BUTTE VALLEY, CALIF.—The completion of the Butte Valley Irrigation District, comprising 28,000 acres of land, and bringing 10,000 miners' inches of water into Miess Lake from Butte Creek, Antelope Creek and Bear Lake, was celebrated with appropriate ceremonies on May 16th at a great community gathering near Macdoel.

SACRAMENTO, CALIF.—Among the bills passed by the California legislature and approved by Governor Richardson were Senate Bill 228, appropriating $94,125 for water surveys under the state division of Water Rights, and Assembly Bill 162, appropriating $20,000 for assisting the federal Interior Department in stream gauging in California.

KANSAS CITY, MO.—The Green-Beekman Construction Company, of this city, has been awarded a three-million-dollar irrigation and drainage contract on the Bardley project, near Phoenix, Arizona. The lands to be irrigated under this project are located nineteen miles to the northeast of Phoenix, and include 38,000 acres.

LOS ALAMOS, CALIF.—Ranchers of the Los Alamos, Santa Ynez, and Lompoc districts, Santa Barbara County, met with the Chamber of Commerce of Los Alamos recently to go into the final details of plans to irrigate 50,000 acres from three reservoirs, taking water from the Santa Ynez River. H. H. Henderson, engineer, is largely responsible for the plans of the understaking.

CARSON CITY, NEVADA.—Specifications and plans for the construction of an additional reservoir in the Lovelock Valley, Pershing County, Nevada, are in the course of preparation and will be submitted to a committee of citizens of Lovelock who have the work in charge. If consummated this project will provide 100,000 acre-feet of storage for use in the Lovelock Valley.

POCATELLO, IDAHO. — The great American Falls dam on the Snake River, twenty-five miles west of this city, will be formally dedicated with elaborate ceremonies on July 13th, with a crowd of participants expected to number more than 40,000 persons. The dam will impound 1,700,000 acre-feet of water as completed, with a potential capacity of 3,000,000 acre-feet, and will cover 61,000 acres of land.

MANTECA, CALIF.—By an overwhelming majority, voters of the South San Joaquin and Oakdale Irrigation Districts during May voted a bond issue of $2,200,000 for the construction of the Melones Dam, to be built on the Stanislaus River, nine miles below the town of Melones. The reservoir will be nine miles long and will store 110,000 acre-feet of water, to be used in irrigating 144,000 acres of additional land in both irrigation districts.

IMPERIAL, CALIF.—Peak flow of the Colorado River was attained June 12, for the year 1925, at 48,000 second feet, according to Chief Engineer Ray S. Carberry, of the Imperial Irrigation District. This flow represents a new low record. Flood peaks in former years have been: June 24, 1925, 65,800 second feet; June 8, 1923, 100,000 second feet; June 10, 1922, 115,000 second feet; June 28, 1921, 185,000 second feet; June 8, 1920, 190,000 second feet.

SANTA ANA, CALIF.—Current irrigation problems are being discussed in a series of meetings held in Orange County under the auspices of the Farm Bureau. Meetings are being held in seven different cities of the county, in various parts of the citrus growing area. Discussion of actual problems facing the ranchers who participate in the meetings will be featured, with an examination of soil borings and recommendations by specialists in charge.

PHOENIX, ARIZ.—The Salt River Valley Water Users' Association is rehabilitating the old power canal that parallels the southern shore of Roosevelt Lake. This canal, twenty miles in length, ends at the dam far above the present water level. With its "head" of 220 feet, it is estimated that much power may be added to the product of the hydroelectric works below the dam with loss of a relatively small amount of water. It cost $1,200,000 and furnished power for most of the dam construction work.

PHOENIX, ARIZ.—A series of experiments being performed by H. Stewart, Maricopa County Agent, C. A. Catlin, and B. J. Showers, to examine the effect of deep-well water in alkaline regions, may reveal some entirely new facts in relation to problems of water wells in alkali soils. The general theory that such wells bring alkali saturated water from deep strata and deposit the salts on the earth is being disputed. The experiments are expected to show that such is not the case, but that the deep wells actually remove alkali from the surface.

farmer to be able to turn on his own private rainfall whenever his fields require water. In this way sunshine and rain work together simultaneously and the result is shown in abundant crops.

Let the visitor look for himself upon conditions as they are developing today in California. As he passes through our great valleys he sees on all sides large farms being cut up into smaller tracts planted, variously, to fruit, vines, rice, alfalfa, grain, garden truck or some other crop that brings immediate and large returns to the farmer. If he looks farther he finds that the most important thing in connection with this intensified farming is the application of water to the land, and, going still one step farther in his investigation, that in a rapidly increasing percentage of instances the water is being pumped from wells and the pumping plants being driven by electric power.

In California, alone, it is estimated that on the ranches there are 35,500 electric motors in operation. These motors total approximately 483,965 horsepower. Eighty per cent of them are used for driving irrigation pumps. With such an unusually large consumption of current, judging by middle western and eastern standards, the electric light, heat and power companies can afford to sell power at a low cost and still make a profit. As a result, there is a general use of electricity for lighting and for barn power operations. In the interior valleys, where wood, coal or oil is not readily available, cooking to a large extent is done by electricity. The favorable climatic conditions of the far West encourage the use of electricity for this purpose and it is estimated that there are 10,000 electric ranges in use on California farms.

SO MUCH for the relation of electricity to modern agriculture as a general thing. But there is more to the subject in these enlightened times. There is cooperation, by which is meant cooperation between the power companies and the agriculturists themselves, the water users, the irrigation districts, the private irrigation enterprises and all others having to do with the development of the soil in the great valleys that stretch the length and breadth of California. That cooperation was much in evidence during the water shortage of last year, and it is safe to say that thousands of acres of fruit and farm lands which, but for skilful management in an emergency, would have gone short of the life giving sustenance that lies back of the electric pump, were saved from disaster by just such cooperation.

As a case in point, this was the situation in Placer County when it was found

How Electricity Serves the Irrigator

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that by July 1, 1924, the beginning of the fruit season, the stored water would be fifty per cent short of the average. Under such circumstances it would have been to the advantage of the electric service companies supplying that region to restrict the use of water at the beginning of the fruit season in order that its storage might be larger in the fall; but such early restriction would have run counter to the desires of the growers who wanted water to mature their fruit. Instead of pulling and hauling in different directions, officers of one of the larger power companies and representatives of the Placer County Water Users' Association, made up of land-owning fruit growers, sat down together to discuss the situation. The company's district manager put his cards on the table, so to speak. He told how much storage the company had and how much water would be needed to meet district and railroad demands which, by law, take precedence over all others. The growers checked the company's figures and an agreement was reached by which the association agreed to cooperate in an effort to avoid all possible waste, while the company, on its part, agreed to supply the growers with water as it was needed.

Both sides kept the faith and the result was that the irrigation period came and went with everybody satisfied. The agricultural situation was saved.

THE relation of electricity to agriculture is a problem engaging the attention of some of the greatest minds in the country. There is a national committee, which works under a competent agricultural engineer as director, whose chief task is to determine the maximum economic uses of electricity in agriculture. The work is organized on a state basis, being distributed among state committees similar in organization to the national committee whose personnel is made up of representatives from the American Farm Bureau Federation, the National Electric Light Association, the Power Farm Association, the American Association of Agricultural Engineers and the United States departments of Agriculture, Commerce, and Interior.

The state of California has participated in this movement for upwards of a year. The State Committee on the Relation of Electricity to Agriculture is headed by Professor L. J. Fletcher of the College of Agriculture, University of California, and its members include a number of power company representatives. The agricultural "load" is increasing every day. Take, for instance, the Pacific Gas and Electric Company's system; the record shows that in 1922 service was supplied to 12,500 agricultural consumers, cultivating a total area in excess of 450,000 acres, who consumed a total of 108,181,961 kilowatt hours, or 240 kilowatt hours per acre. The total agricultural connected load on this company's system at the end of the irrigating season in 1924 was 177,715 horse power, and the sales of agricultural power 135,306,000 kilowatt hours.

Modern Irrigation's Advisory Board

(*Continued from Page 24*)

trol of the Santa Ana River watershed. In these capacities, Mr. Cuttle has been actively engaged during all of the past thirty-eight years in the development, delivery and conservation of water. He was a member for five years of the California Conservation Commission, and is at present a member of the State Board of Forestry, taking an active interest in the conservation of forests and watershed cover. His residence is at Riverside, California.

M. B. Pratt is State Forester of California. His special interest in irrigation is in its relation to the problems of forest-cover conservation. Mr. Pratt is president of the Association of State Foresters, and an acknowledged authority in his particular field. He completed his academic education at Yale University in 1905 with the degree of Master of Forestry and was connected with the United States Forest Service for nine years, resigning to enter state service in California. He served as assistant professor of forestry in the University of California for four years, subsequently becoming deputy state forester, and was appointed state forester in 1921. "I have long felt," declares Mr. Pratt, "that the industries dependent upon irrigation do not fully realize the significance of the co-relationship between watershed cover and water, and the effect upon continued prosperity of irrigated areas through the denudation of our mountain slopes."

Paul G. Redington is District Forester, United States Forest Service, with headquarters at San Francisco, and is also designated as the western representative of the Federal Power Commission to handle such water power activities as relate to the National forests. Mr. Redington is a graduate of Yale University, with the degree of Master of Forestry, and has served with the forest service in various capacities since his graduation, including that of inspector, supervisor and district forester in most of the National Forest states west of the Mississippi River.

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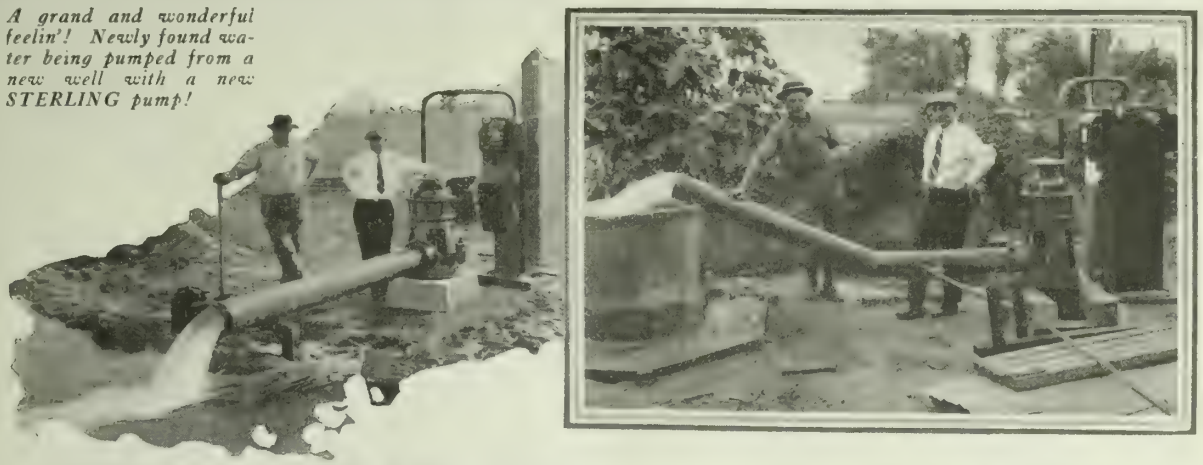

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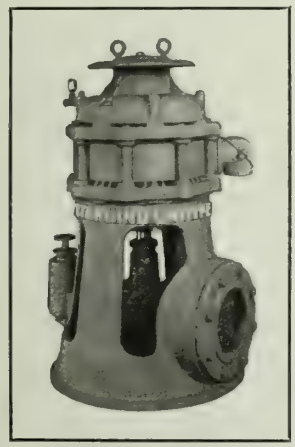

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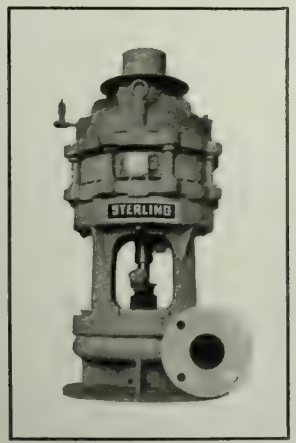

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IRRIGATION MANAGEMENT

SOME PROBLEMS OF A MUTUAL WATER COMPANY

By RICHARD BARD

President, Zone No. 1 Mutual Water Company, Ventura County, California

IRRIGATION is the artificial application of moisture to the soil. In Southern California, the development of every specialized crop, such as oranges, lemons and walnuts, has been dependent upon the successful development of water for irrigation purposes. Without irrigation these industries would shortly perish, the orchards die or the production fall off to the point where the return would be less than the expense of raising the crop.

The entire citrus and walnut industry has succeeded because the orchardist is not dependent upon the natural rainfall but can supplement nature's supply with moisture artificially applied at times and in amounts exactly suited to the needs of each particular orchard. Consequently, in California, this need of water has given rise to the formation of irrigation districts, public utility companies, mutual water companies and private systems on a scale perhaps the largest and most highly developed of any irrigation system in the world.

In some regions of California water is very difficult to develop; while in others, artesian wells can be put down at small expense and operated at almost no cost.

THE cost of water is usually based upon the head delivered for 24 hours. This ranges from five cents per miner's inch for 24 hours in large districts where open ditches are used, and where the pumping head is nominal, or else gravity flow, to $1.00 per miners inch for 24 hours in districts where the supply is scarce and the pumping lift is tremendous; as, for instance, 700 or 1000 feet. It can readily be seen that the more costly the water, the greater the necessity for measuring carefully the amount of water delivered.

MAIN PUMPING PLANT OF ZONE NO. 1 MUTUAL WATER COMPANY, SHOWING INSTALLATION OF BYRON JACKSON PUMPS DIRECT-CONNECTED TO WESTINGHOUSE MOTORS.

Some companies rely entirely upon guess work to determine the amount of water their users consume and, in some instances, have no standard charge but pro-rate the expense among their stockholders at the end of the year by levying assessments to cover all charges. Public utility water companies are, of course, compelled to submit a rate determined by the Railroad Commission. But Mutual Water Companies, with which the writer is more familiar, are organized with the idea in mind to deliver water to their stockholders at cost. The cost element is variously determined by different companies, but it is pretty well established that in figuring cost of delivery the following items should be included: power, repairs to lines, machinery, wages of superintendent and linemen, supplies, small tools, office help, officers' salary (if any), stationery and supplies and all other expenses incident to the delivery of the water.

In addition to the above should be added depreciation of system, machinery and equipment, interest on borrowed money, and amortization of funded debt. The latter charges are seldom calculated in fixing water rates, but they ought to be taken into account and proper reserves set up to allow for depreciation and to build up funds with which to retire indebtedness. It is customary, with most companies, to wait until a new line has to be in stalled or new machinery purchased and then levy a special assessment to cover this outlay. But this is unwise practice and throws a sudden burden upon the stockholders. The only proper way to handle betterments, renewals, and funded debt, is to provide for the same by levying a special charge each year against all the stockholders, equally proportioned upon the basis of stock ownership or acreage involved. In this way actual cash reserves are created, so that in case renewals must be made, or indebtedness must be met, there is cash on hand for the purpose and no special assessment is necessary.

In the particular irrigation company with which the writer is concerned, we have an area of some 4500 acres

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Citizens Land & Water Co.,
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We now have five of your pumps and we are very well pleased with them. The added efficiency you gave us has taken care of the great depth we have to pump this year. Your fair treatment and good equipment deserves the support of every user, and you may use us at any time, —our records are open to you.

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Yours truly,

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Bastanchury Ranch Company, Fullerton	Ten
Blue Diamond Company, Los Angeles	One
Builders Crushed Rock Products Co., Azusa	One
California Country Club, San Bruno	Two
Citizens Land & Water Company, Rialto	Five
City of Alhambra, Alhambra	One
City of Beverly Hills, Beverly Hills	One
City of Compton, Compton	Two
City of El Monte, El Monte	One
City of Huntington Park, Huntington Park	Two
City of Los Angeles, Los Angeles	Five
City of Monrovia, Monrovia	One
City of Santa Monica, Santa Monica	Three
Claremont Domestic Water Company, Claremont	One
Compton Union High School, Compton	One
Consumers Rock & Gravel Company, Los Angeles	One
Fillmore Orchard Company, Fillmore	Two
Greer Company, Inc., P. H., Bakersfield	Two
Jones, G. Merritt, Porterville	One
Lomita Water Company, Lomita	One
Michigan Land & Water Company, E. Pasadena	One
Montebello Land & Water Company, Montebello	One
Moorpark Farmers Water Company, Moorpark	One
Omaha Water Company, Covina	One
Pellissier, F. F., Whittier	Two
Perkins Rock & Gravel Company, San Fernando	One
Platt, George E., Los Angeles Creamery Co.	Three
Rio Hondo Country Club, Downey	One
San Juan Point Corp., Laguna Beach	One
San Pedro Golf Club, San Pedro	Two
South Mesa Water Company, Redlands	One
Southern California Edison Company	Four
Yorba Linda Water Company, Yorba Linda	One

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under the system, divided into two different areas or zones, based upon elevation. The first zone comprises about 3,000 acres, the average pumping lift being 200 feet, and the second zone 1,500 acres, with an average pumping lift of 400 feet.

Our charge for water in the first zone is thirty cents per miner's inch for twenty-four hours, with a yearly depreciation charge of $1.20 per acre, and our charge for water in the second zone is fifty cents per miner's inch for twenty-four hours, with a depreciation charge of $1.80 per acre. This system has now operated two years and we find that our charges for water are ample to pay all expenses, with every likelihood that we will be able to reduce the rates as our system is used more.

When we started the construction of the system we considered carefully the matter of measuring devices. There was no question as to the advantage of installing some kind of device, but the particular make and unit of measurement was a matter of choice. After much investigation we determined upon the Sparling meter as being the most practical field meter for our particular needs. We now have nearly 100 of these meters installed and operating. They have given very satisfactory service and are the basis and final court of appeal in all controversies regarding the amount of water delivered to users.

THERE is no question in our minds that it is absolutely necessary to have measuring devices installed in any modern system. If one relied entirely upon the zanjero to estimate the flow of water and the number of hours it flowed, there would arise constant controversies on the part of the farmers as to the actual amount of water received. It is impossible to regulate the flow through a pipe-line so that it will remain constant for a given length of time. This being the case, the farmer would always have occasion to doubt whether he got the amount of water paid for and, consequently, a feeling of dissatisfaction would arise in his mind and a belief that he was being treated unfairly and on a different basis than his neighbor; all of which makes smooth running and cooperation impossible—the essential need of every mutual company.

Therefore if, at a very nominal expense, meters can be installed which will make the calculation of water deliveries automatic and beyond dispute, it would certainly pay every company and in fact every individual user to adopt measuring devices for its or his particular system.

Not only is it valuable to the company to know exactly how much water it is delivering to each user, but it is also extremely valuable to each individual farmer or grower to know exactly how much water he is putting on the land. Without such measuring devices, the farmer is working blindly and often wastes his water; or else he fails to put on enough water, with the result that he loses the benefit of irrigation altogether. Any orchardist ought to know how many acre-inches of water his ground has received during the year, in order intelligently to care for his trees.

There are numerous units of measurement of water, such as gallons; cubic feet; second feet; miner inch hours; acre feet and otherwise. For municipal use or domestic use, the unit of gallons or cubic feet is used almost exclusively. In large irrigation districts, particularly in alfalfa regions, the unit is in second feet; but in systems involving orchards the unit usually is in cubic feet or miner's inch hours. We adopted the latter unit as it seemed the simplest and most easy to convert into terms of acre inches. A miner's inch hour is the amount of water which results from the flow of one miner's inch of water for one hour, or in terms of gallons (using 9 gallons per minute for 1 miner's inch) 540 gallons. Thus if a farmer receives a head of 100 miner's inches for twenty-four hours, he receives 2400 M. I. H. Converted into gallons this equals 1,296,000 gallons. As there are 325,850 gallons in each acre foot of water, a flow of 100 M. I. for twenty-four hours is equivalent to approximately four acre feet. Or, in other words, 600 M. I. H. equals one acre foot and 50 M. I. H. equals 1 acre inch.

Therefore if the farmer wants to know how many acre inches he has put on his land he goes to the meter, reads the dial, subtracts the reading from the former reading and divides the difference by 50. This gives him a quick method of calculating his application of moisture to the land.

THE amount of water applied to the land varies with the crop and moisture conditions. Lemons need water every month of the year, walnuts three or four applications, beans one or two applications. Sometimes as high as four acre feet per acre is applied per year, but the average amount used by orchardists in Southern California will run from fifteen inches to two feet per acre.

Last year our company delivered to its stockholders an average of twelve acre inches to each acre irrigated at a cost to the user of $7.50 per acre. The average return to the user in lima beans was 1450 pounds per acre, or, in money, a gross return of $163.00 per acre.

In conclusion let me say that irrigation is the only insurance a farmer or orchardist in Southern California has against dry years. Furthermore, the proper application of water to the soil is the problem which every farmer or orchardist must work out for his own particular needs.

This cannot be done effectively unless he has some sure way of finding out the amount of water he is putting on his land; hence, one of the most important features in any irrigation project is the installation of accurate, easily installed, well built measuring devices. Without them the farmer and the company are lost; with them, intelligent irrigation is made not only possible, but simple.

One Successful Reclamation Project—Orland

(*Continued from Page 21*)

any reasonable terms of repayment available under the Reclamation Law, so that with the completion of the proposed work and the agricultural results from irrigation heretofore obtained on the Orland project, its success in the future is definitely assured.

The project area, originally consisting of a few large holdings and supporting a population of not to exceed 200 in number, has been broken up through the agency of government irrigation to the extent that, even in an adverse drouth year, such as 1924, nearly 700 farms with

SUMMARY OF RESULTS OF IRRIGATION ON ORLAND PROJECT

Year	Acres Irrigated	Crop Value		Land Investment	No. of Farms	Population of Farms
		Total	Per Acre			
1911	2,663	$ 60,218	$24.80	$ 800,000	188	640
1912	4,230	112,924	29.24	1,358,500	211	645
1913	6,616	203,949	34.07	1,709,035	246	896
1914	7,354	176,331	26.99	2,073,965	296	1,333
1915	8,928	220,422	31.81	2,100,300	351	1,258
1916	9,357	342,399	48.83	2,538,342	384	1,260
1917	12,729	543,573	56.57	3,281,650	531	1,518
1918	14,764	709,172	58.73	3,648,100	593	1,689
1919	15,203	892,259	71.90	4,894,645	600	1,768
1920	13,872	549,698	49.80	5,419,350	644	1,844
1921	14,697	495,810	43.32	5,557,810	663	1,892
1922	15,119	565,556	47.92	6,123,000	693	1,909
1923	15,500	675,967	54.40	6,235,950	703	1,945
1924	11,962	224,952	22.57	6,131,550	673	1,750

a population of 1,750 were being operated and irrigated. During the same interval, the population of Orland increased four-fold.

The water supply for the Orland project is derived from Stony Creek, a tributary of the Sacramento River, originating in the Coast Range mountains. The irrigation plan provides for storage in a reservoir of 51,000 acre-feet capacity, controlled by East Park Dam on Little Stony Creek and a feed canal, seven miles in length, connecting the storage basin with main Stony Creek. For the irrigation of project lands, water is diverted from Stony Creek at two points into the South and North Canals by means of low diversion weirs. The natural flow of the creek is utilized for irrigation requirements during the early months of the season and is later supplemented by storage.

The stored water is conveyed from East Park reservoir in the natural creek channel some 40 miles before being diverted into the distribution system, comprising 138 miles of canals and laterals, 90 miles of which are concrete lined.

The soil at Orland consists of alluvial deposits from Stony Creek with an admixture of wash from an adjacent, more elevated area. The varieties are gravelly loam, clay and sediment loam, all deep and very productive. The general slope of lands within the project is about 15 feet to the mile, affording excellent surface drainage. The subsurface drainage is equally as good, so that after 14 years of irrigation on the project no drainage problems, originating from a general rising of ground water levels, have occurred.

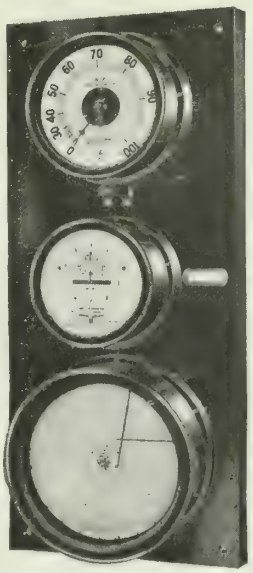
The average elevation of the irrigable area of the project is 250 feet above the sea level, the variation being from 180 to 320 feet. The mean annual temperature at Orland, as derived from Weather Bureau records extending over some 40 years, is 64 degrees. The normal rainfall is 18 inches per season, which occurs usually between November 1 and March 1. The irrigation season normally extends from April 1 to October 1, with some irrigation of citrus and olives in October and November.

All land in the Orland project is in private ownership. Land was purchased by new-comers from the original owners at prices varying from $75 to $125 per acre for unimproved property and from $300 to $1,200 per acre for improved property.

The limit of ownership has been established at 40 acres, except that original subscribers (and their successors in interest) to stock in the Orland Unit Water Users' Association are qualified to hold an area not in excess of 160 acres.

Advantages of Electrically Operated Water Meters for Irrigation Purposes

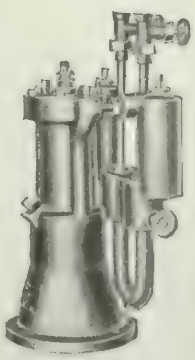
ELECTRICAL operation means flexibility in water meters, as in all electrical appliances. The meter body may be installed in the most inaccessible places, while the indicating, totalizing and recording instruments can be located in the most convenient places, as engine rooms or in the office.



This is made possible because the meter body is electrically wired to the reading instruments, thereby eliminating the necessity of having the meter body and reading instrument close to each other.

This electrical operation insures absolute accuracy. There are no errors due to friction resulting from mechanical appliances as floats, cams, levers, glass and stuffing boxes.

In deciding on water meters for irrigation purposes, it is well to keep in mind the following points that are found in Republic Water Meters. They result directly from the use of the thin plate orifice and electrical operation.



1. **Insures accuracy.**
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HYDRAULIC ENGINEERING

Dealing with the Problems of the Irrigation Operating and Consulting Engineer

HINTS ON THE USE OF CONCRETE IN IRRIGATION

By J. E. JELLICK

District Engineer, Portland Cement Association, Los Angeles

CONCRETE pipe systems have been extensively used for irrigating land in the western states for the past thirty years. Investigations conducted by the United States Department of Agriculture, and by agricultural colleges in irrigated regions, show that vast areas of highly productive land are being ruined because of inefficient irrigation methods. This loss of productive capacity in many cases can be practically eliminated by carrying the water required for irrigation in modern pipe systems.

In 1921 the United States Department of Agriculture published a bulletin entitled "The Use of Concrete Pipe in Irrigation", prepared under the direction of Dr. Samuel Fortier, a recognized authority on irrigation. The importance of efficient irrigation systems is emphasized in the following statements by Dr. Fortier, quoted from that bulletin:

"In recent years, owing to the rapid increase in the value of soil products, intensively farmed land under irrigation systems has risen in many cases to double its pre-war value. This great advance in the value of irrigated land has placed a premium on water, and a widespread effort is being made to convey, distribute and use the appropriated waters in such a way as to incur the least possible loss. Every gallon of water wasted by seepage and absorption in porous earthen channels or in careless use on the land robs the farmer of so much profit; whereas, every gallon saved protects fertile soil from water-logging and results in larger yields and profits to the grower.

AN experience covering a period of over a quarter of a century on the Pacific Coast, and more especially in California, has demonstrated that large quantities of water can be saved by the substitution of pipe for earthen ditches. The results of a large number of measurements made by the irrigation division of this bureau show that the transmission losses in earthen channels vary from 10 to 60 per cent and average fully 35 per cent of the quantity of water admitted through the intake. When pipe are substituted for earthen channels, the loss of water in conveyance is usually negligible.

"The use of pipe for the carriage of water and of pipe systems for its distribution to farmers not only prevents loss of water, but affords better facilities for its control, distribution and delivery. Irrigating land by means of open channels in earth is a laborious and unpleasant task, wasteful of water, time and effort. On the contrary it can be rendered comparatively easy and pleasant if the proper equipment is provided in the way of pipe, pipe systems with proper gates, turnouts and other fixtures. The interest on the cost of such betterments for highly profitable crops is more than likely to be amply compensated by the water and labor saved and a more uniform moistening of the soil."

Efficient methods of irrigating land are being developed at the University of California Experimental Farm, Davis, California, under the direction of Professor S. H. Beckett, an authority on irrigation matters. The recommendations of Professor Beckett are contained in booklets published by the Portland Cement Association, and are available upon request.

The following valuable suggestions on laying concrete pipe are quoted from the government bulletin "The Use of Concrete Pipe in Irrigation", previously mentioned:

"Concrete pipe should be laid deep enough in the trench so as to reduce the range of temperature and to be safe from injury against plows, subsoilers or other farm implements. There should be at least 12 inches of earth over the top of all kinds of pipe, and high pressure pipe should have a top covering of at least 18 inches. Temperature changes in the shell of the pipe are greatly reduced when the pipe is buried deeply, and less trouble is experienced from expansion and contraction. The moisture content within the shell of the pipe is likewise kept more uniform than where the upper half is laid near the surface of the ground.

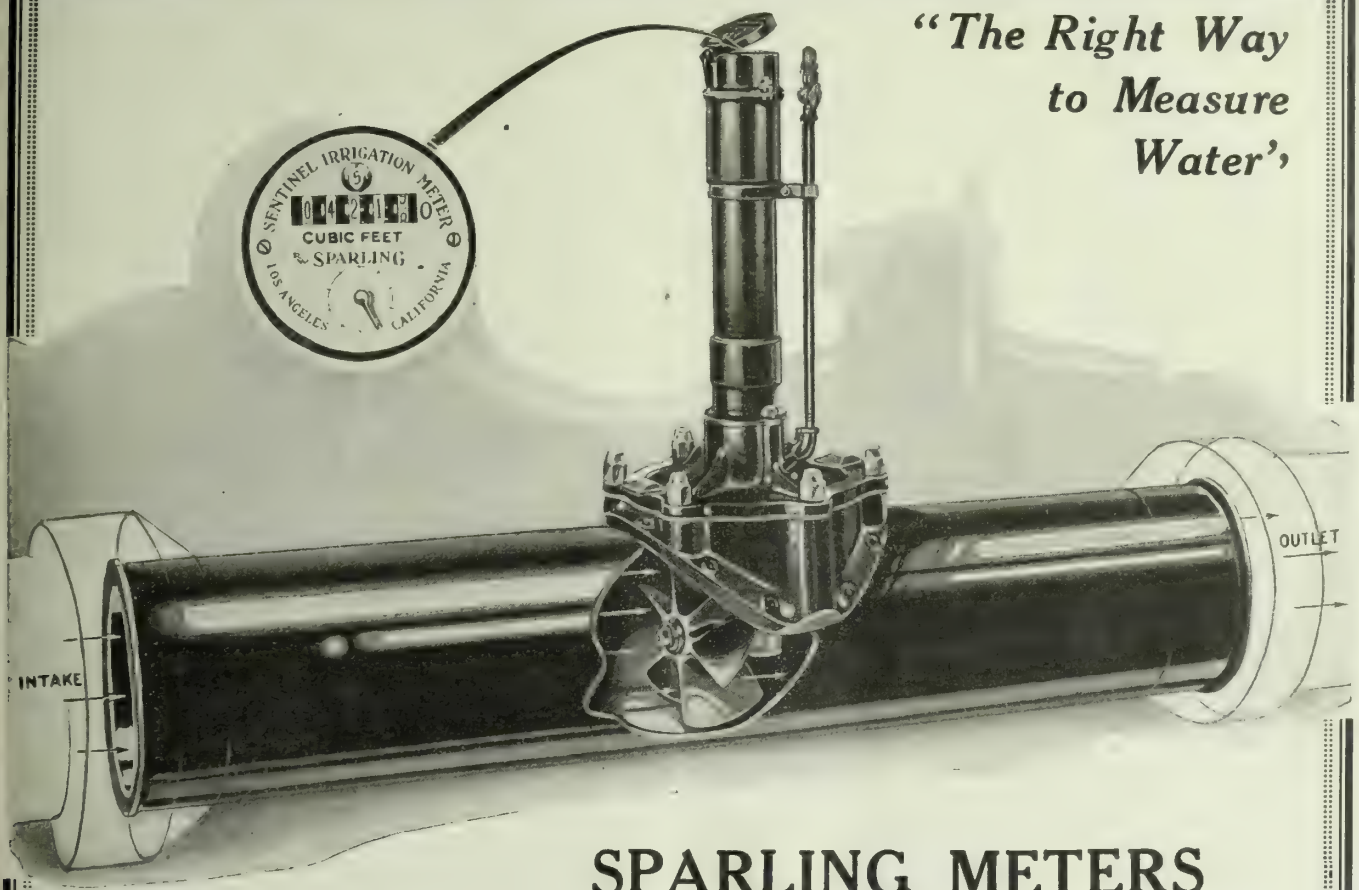
"Most experienced pipe layers lay small sizes of pipe by standing the joint to be paid on end and filling the groove end with mortar. The pipe is then firmly pressed against the tongue end of the pipe that is already laid in the ground, care being taken to get a good bond of mortar between the ends of the

THE WASTEWAY PIPE SET AT AN ANGLE IS DESIGNED TO PREVENT AIR TROUBLES.

WHERE A CONCRETE PIPE SYSTEM WATERS THE HILL TOPS AS WELL AS THE VALLEY.

THIS EXETER (CALIF.) VINEYARD GETS ITS WATER THROUGH A CONCRETE SYSTEM.

"The Right Way to Measure Water"



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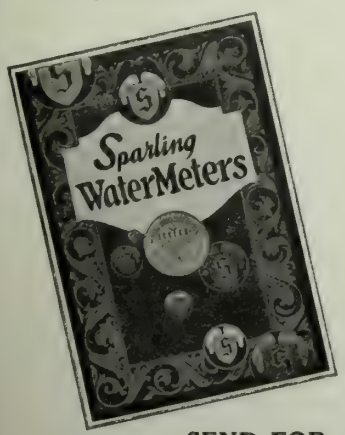
Water is too valuable to be handled carelessly and user and producer should be protected by the impartial certainty of meter measurement. The Sparling Meter provides an accurate record of the EXACT amount of water passing through it—eliminates guess work and disputes, and assures a "square deal" to all.



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LOS ANGELES

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pipe. The mortar is smoothed off with a trowel on the outside and the inside brushed smooth with a long-handled brush. The ends of the pipe are always wetted with a brush before applying the mortar.

"After the trench is dug and the pipe to be laid strung along the side of it, one expert pipe layer, with two helpers, will sometimes lay as much as 1,200 feet of 8 to 12-inch pipe in a day, but 800 feet is a good day's work for an average crew. Four men are usually needed to lay pipe from 14 to 18 inches in diameter and will average 300 to 500 feet of this size in a day. Five to seven men will lay from 300 to 500 feet of 24-inch pipe in a day.

FAVORABLE conditions for laying concrete pipe depend upon temperature, moisture in the pipe when laid, and moisture in the ground. Pipe laid in winter, when the ground is moist from rains, seldom gives trouble, especially if the pipe is kept continually full of water after being laid. Pipe laid in sandy soil, when the ground is hot and dry, is almost certain to develop contraction cracks unless water is turned in promptly. If it is necessary to lay pipe in hot, sandy soil, the trench should be deep and the backfill kept moist until water can be turned in. As bands and joints sets very rapidly, pipe can often be filled with water 24 hours after laying. Heavier soil containing moisture will protect the pipe from drying out. If the pipe is dry when laid, and the soil is dry and warm, there will probably be little change in the length of the pipe until it is filled with water, but when the pipe is thoroughly soaked there is likely to be considerable expansion."

Irrespective of its diameter, pipe should show no leakage under a hydrostatic pressure of 15 pounds per square inch, maintained for a period of five minutes. This pressure is equivalent to a head of approximately 35 feet. Moisture merely penetrating the shell of the pipe and adhering to its surface should not be considered leakage.

The outer surface of pipe made with concrete of correct semi-dry consistency should have distinct web-like markings. This indicates that the proper amount of water has been used to give maximum strength and minimum absorption.

When struck with a hammer a properly made concrete pipe will produce a clear ringing, metallic sound.

It is not intended to cover all phases of the subject here, as an article of more or less general nature is all that space permits of, and reference is again made to the publications of the Portland Cement Association which are available to anyone upon request.

Southern California Water Problems

(*Continued from Page 18*)

Mountains are conspicuous, while in the region of the San Gabriel River they are practically absent.

A water supply anywhere near the average of a cycle requires the storage of hundreds of thousands of acre feet, which may have to be carried over for several years.

There is a further conspicuous irregularity in the seasonal run-off of the years of any one period. The dry period of 1893-1904 produced in the San Gabriel River and tributaries the following run-off:

A maximum seasonal of.....177,000 acre feet
A minimum seasonal of..... 9,700 acre feet
And an average of..... 61,600 acre feet

It will, therefore, require large storage to maintain the average of a dry period. No surface reservoirs are available to store such volumes of water. However, a kind Providence has given us large groundwater basins, arranged in series so that practically a full utilization of the local water supply is possible.

The records of streamflow in Southern California go back only about thirty years, those of rainfall generally about fifty years and for the city of San Diego, seventy-five years.

The investigations of the Carnegie Institute indicate periods during which the rainfall fell below our present dry period records by 30 per cent.

Computations of safe yield of large watersheds like that of the Valley of Southern California, and upon which large territories depend for their continued development, should, therefore, be discounted by an additional safety factor.

THE Valleys and Coastal Plains within the territory here considered are sunken basins of depths of 1,000 feet or more reaching, in most instances, considerably below sea level. They are filled with irregular deposits of sand, gravel and clay, alluvial deposits of the streams issuing from ranges of crystalline formation and are capale of absorbing large volumes of water. The streams crossing the valleys and the rainfall on the valley floor produce seepage which ultimately reaches the ground water table and thence gradually moves to the ocean. Most of the valleys have more or less constricted outlets, like the San Fernando Valley, at Glendale; San Fernando Valley, at Glendale; San Gabriel Valley, at Whittier Narrows; the Santa Ana Valley, at Rincon near Corona; the Coastal Plains, at Palms; on both sides of Signal Hill; and between Newport and Alamitos Beach. The outlets of the Coastal Plains are gaps cut into the oil anticline which extends from Newport Beach to Huntington Beach, Signal Hill, Athens and Beverly Hills.

In the upper valleys the ground waters, backed up by these constrictions, rise to the surface in the stream channels and produce rising streams, such as the Los Angeles River, at Griffith Park, which has a flow of 45 to 80 sec. feet; the San Gabriel River, at Whittier Narrows, flowing 60 to 120 sec. feet; and the Santa Ana River, at Rincon, flowing 50 to 150 sec. feet.

In the Coastal Plains the ground waters do not drain into channels but rise generally to the surface of the ground and produce moist areas from which the water evaporates. Cased wells sunk in these moist areas have an artesian flow.

All these basins are of colossal dimensions embracing, in some instances, hundreds of square miles and they are, therefore, capable of storing and regulating enormous quantities of water which no surface reservoir could accomplish.

The effect of periodical fluctuations of water supply on the groundwater levels in apparent from well observations extending, in a few instances, over a period of about 30 years and, for large numbers of wells, over 20 years. Water levels rise and fall in sympathy with precipitation and streamflow. As all basins are under a more or less uniform natural draft, either by percolation at the outlet or by water rising to the surface, the effect of a subnormal seasonal wetness will produce a deficient recharge as compared with the natural draft and vice versa. The cumulative effect over a dry period is, therefore, a gradual recession of the waterplane, reaching its low water mark at the end of the dry period. With a wet period, gradual recharge sets in until at the end of the same, peak conditions are reached. These groundwater basins, individually, effect an imperfect natural cyclic storage to the extent of their recharge.

The development of horticultural farming in Southern California (with the exception of the San Fernando Valley) and the remarkable crop yields of this semi-arid country over wet and dry periods alike have been made possible by the available underground storage.

In these ground water basins Nature has indicated how storage of the flood-waste and of a supplementary supply must be taken care of if this country shall be fully developed and be independent of the periodical fluctuations of local water supply.

LOS ANGELES COUNTY has a Flood Control but no Conservation organization. Its flood control plans provide for a system of surface detention reservoirs, the largest one being that proposed for San Gabriel Canyon with a capacity of 240,000 acre feet at an estimated cost of $25,000,000.

The requisite capacity of these reservoirs for flood control purposes depends not only on the flood flow but also upon the magnitude of the efflux during floods and is, therefore, directly related to the question of conservation.

The County, however, has no concerted plans for the conservation of floodwaste. Within the metropolitan area outside the city, there are a great number of water supply organizations, most of which, for growth in the immediate future, depend upon conservation. It is felt that unless their interests are consolidated and co-ordinated with the flood control plans, no systematic utilization of the flood waste can be made.

In the Santa Ana River watershed conservation by spreading flood waste on the debris cones is practiced on a large scale, the principal organizations being the Conservation Association operating on the Santa Ana Cone and the Pomona Valley Protective Association, on San Antonio Creek. Direct diversions are made, without detention storage, as soon after peaks as the water is reasonably free from silt and danger of breaks is past. The ultimate consummation of conservation must be handled in connection with flood control detention reservoirs, both for engineering and for economic reasons.

The plans of Mr. William Mulholholland, Chief of the Lost Angeles City Water Department, provide for the diversion of 1,500 sec. feet from the river for domestic use of the cities in the Valley of Southern California. The length of the aqueduct is approximately 250 miles, involving a pumping lift of about 1,400 feet. Large storage will be required at this end. Generally speaking, surface storage sites are scarce and they have to be used at times for flood control purposes. Underground storage is available and will likely be utilized, with the underground storage of Owens River Aqueduct water in San Fernando Basin as a precedent. About 150,000 acre feet of water has been stored in that Basin underground as seepage from irrigation, with the effect of increasing the dry period flow of the Los Angeles River by 20 sec. feet. Supplementary as is this Colorado River supply, its use must be co-ordinated to the local supply, so that the rational utilization of all water sources resolves itself into one problem within each principal watershed.

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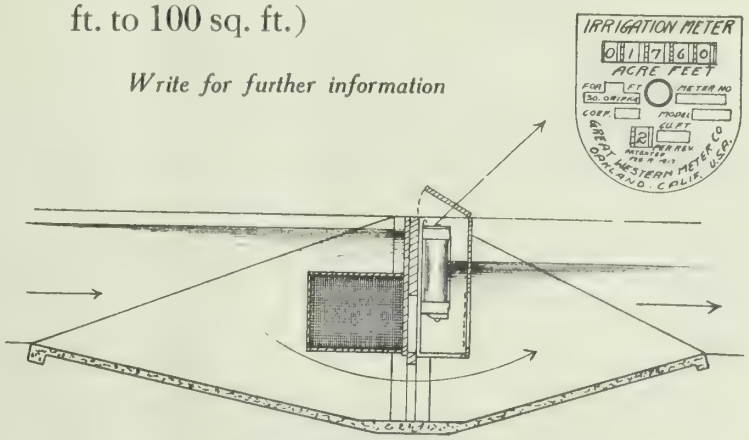

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WHO'S *WHO* AND WHO'S *WHERE*

IN IRRIGATION AND RECLAMATION

Personal Notes and Impersonal Observations About Men You Know

Everett M. Paul, formerly director of the sixth agricultural district, Los Angeles, California, has resigned his state position to become manager of the Sun Maid Raisin Company. His home will be in Fresno.

The Governor of Oregon and the Secretary of the Interior have recently designated W. A. Delzell, of Salem, Oregon, to serve on the Board of Survey and Adjustments in connection with the review of reclamation matters in Oregon.

Frank Evans, of Salt Lake City, Utah, has been named General Marketing Counsel and Secretary of the American Farm Bureau Federation, by its Executive Committee. Mr. Evans has served for three years as attorney for the Utah State Farm Bureau, and has been a director of the National Federation for the same length of time.

B. F. Williams of Kaufman has been appointed state reclamation engineer of Texas succeeding Arthur A. Stiles. Mr. Williams has been engaged in general engineering practice for the last fifteen years. Mr. Williams says it shall be the policy of his department to provide the people of the state with adequate and accurate engineering data on economical and safe flood control.

Colonel William Kelly, Corps of Engineers, U. S. Army, who has served as chief engineer of the Federal Power Commission since September 1, 1920, has been granted an extended leave of absence by the War Department. The vacancy thus created has been filled by the designation of Major Glen E. Edgerton, Corps of Engineers, to be chief engineer.

Knowles Ryerson, Farm Adviser of Los Angeles County, California, has left on an extended leave of absence for Haiti, where he will have charge of the horticultural work at the new experiment station and agricultural school being established there under the direction of the United States. M. B. Rounds, assistant farm adviser, has been appointed to his place during his absence.

Raymond F. Walters became chief engineer of the United States Bureau of Reclamation on May 1, after serving with the bureau since 1903. Since the resignation of former Chief Engineer Weymouth last year, Mr. Walter has been acting chief and on May 1 became the official head of the engineering department. His headquarters are at Denver, Colorado, and he is a graduate of the Colorado Agricultural College.

Louis C. Hill of Los Angeles, Major General W. C. Langfitt, and Fred A. Noetzli of San Francisco have been named members of the advisory board of engineers which will be in responsible charge of the construction of the Coolidge dam and the San Carlos project in Arizona. The personnel of the advisory board has been approved by the Commissioner of Indian Affairs at Washington, D. C.

A party consisting of C. E. Grunsky, Jr., engineer of San Francisco; Vern Freeman, engineer for the Santa Clara River Protective Association; A. C. Hardison, president of the California Farm Bureau Federation, and Harry Valentine, district forest ranger, spent several days during June in the back country of Ventura County with a view to determining the extent of the Santa Clara watershed. They are making particular note of possible dam sites.

Charles H. Fitch, of the Washington office of the United States Bureau of Reclamation, retired recently from professional labors at the age of seventy years. His activity in government service covered a period of more than fifty years. He was attached to the Bureau of Reclamation from the time of its organization, in 1902, until his retirement. From 1911 to 1916 he was project engineer of the Salt River Valley project, Arizona.

Robert W. Hodgson, associate professor of subtropical horticulture in the University of California, and formerly farm adviser in Los Angeles County, is conducting one of the principal classes in the summer school which will be in session from June 27 to August 8 at the Citrus Experiment School, Riverside, California. The course will cover citrus culture from many angles, including some very practical work in irrigation problems.

Succeeding Frank T. Payne, acting commissioner ad interim, W. J. Everett has been appointed state commissioner of conservation in Louisiana. He was formerly private secretary to Governor Fuqua, of that state. His acquaintance with reclamation activities in Louisiana is extensive, and he was for some time a professor in the Louisiana Polytechnic Institute at Runston; later engaging in newspaper work in various parts of the state.

F. E. Weymouth, formerly chief engineer in the United States Bureau of Reclamation, recently resigned that office to accept private employment. Mr. Weymouth had been connected with the reclamation service since 1902. His career has included a great variety of significant accomplishments in engineering work, both in this and other countries, including the construction of the Arrowrock Dam, in Idaho, the highest structure of the kind in the world.

Senators L. D. Dennett, of Modesto, and Ralph Swing of San Bernardino, Assemblymen Water J. Little, Hermosa Beach, and A. C. Finney, of El Centro, are the Californians appointed as a committee to represent the state in the allocation of waters of the Colorado River. Pursuant to an act of the 1925 California legislature, this committee is empowered, after due investigation, to enter into an agreement with Arizona and Nevada determining the rights of the three states to share in the waters of the river.

Dr. Hubert Work, Secretary of the Interior, and Dr. Elwood Mead, Commissioner of Reclamation, have left Washington on an inspection tour of the west and northwest, which will require about a month for its completion. They will visit a number of reclamation projects and several national parks en route. Their itinerary includes stop-overs in Colorado, Wyoming, Oregon, Washington, Montana, and Idaho.

Well No. 23 E. O. S. on the Salt River Valley Water User's Association. This Kimball pump is delivering 552 Miners' Inches or over 6200 gallons per minute. Some idea of its size may be gained from the picture below.

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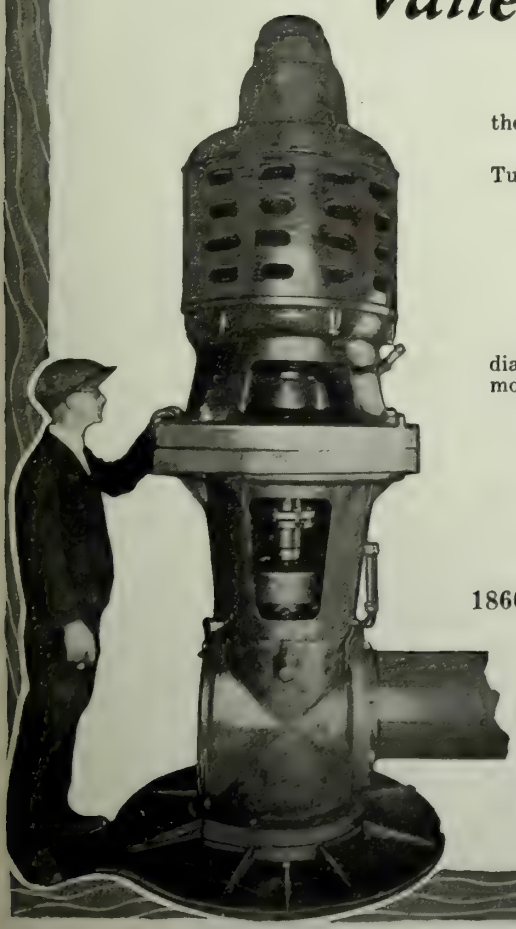

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RECLAMATION

A SURVEY OF THE NATIONAL RECLAMATION OUTLOOK

By DR. ELWOOD MEAD

Commissioner, U. S. Bureau of Reclamation

OUR whole country is interested in the continuation and success of the national reclamation policy. On this depends the growth in population and wealth of some of the arid states.

Conditions created by the Great War have put an end to important irrigation development by private capital. This result has come through increase in construction cost and lessened profits of farming.

The money for building Federal irrigation works and to carry on their operation comes from the proceeds of the sale of public land, the repayment of the cost of these works by settlers and a part of the income from oil and timber lands. About $200,000,000 has been expended. It would take $110,000,000 more to complete the old projects and build the new ones for which appropriations have been made.

ON some projects all the money owing the government has been paid; on others the revenue derived has not even covered operating expenses. Last year one of the good projects paid 7 per cent of what it cost to operate it. Another paid only 15 per cent. The original idea of a revolving fund which would return in twenty years all the money invested, so that it could be used over again, has not worked out. One project that owed $440,000 only paid $25,000, or 6 per cent; another project that owed $11,000, paid only $69; another that owed $112,000 paid $6,000. Financial results of this kind would, if universal, soon bring reclamation to an untimely end through emptying the reclamation treasury.

While some projects pay little or nothing, others pay nearly all. Before we approve of entering on larger development which many desire, we should know what has brought about the present situation and put our house in order to meet new obligations. This has been the task of Secretary Work for the past two years.

In order to understand the situation, he created the Fact Finding Commission to ascertain why there were so many complaints, why there was such irregularity in payments and what changes ought to be made. He followed the report of this commission with successful endeavors to secure legislation by Congress. He followed these preliminary steps by appointing a Board of Survey and Adjustment to visit projects where conditions were most unsatisfactory, and acting on his motto that one look is better than a thousand words, he has made a 10,000 mile journey to visit a part of the Federal Reclamation projects and when urgent duties in Washington are attended to, will start on another 15,000 mile journey to visit the remainder.

The experience of the last 20 years, the conclusions of the Fact Finding Commission and what the Secretary has seen on this visit seem to make clear that the reclamation law centered too much attention on construction and gave too little attention to the agricultural and economic conditions. These are the things which measure earning power and ability of settlers to pay. There was a confident but unthinking belief that the building of an irrigation canal would, of itself, create irrigated agriculture. That once this was done settlers would flock in, and regardless of whether they knew anything about irrigation farming, whether they had any money, they could if given a piece of land somehow dig in and succeed.

Although irrigation under canals where water rights are costly requires intense culture and the growing of high priced crops to repay the money, there was nothing in the law that would authorize the selection of settlers, nothing to inform them of what changing a piece of raw land into a farm would cost. The charges imposed on alkali flats and areas of infertile shale were exactly the same as on the richest river silt on the same project.

RECLAMATION development has also suffered from the declaration in the Reclamation Act that all the money expended should be returned to the fund. Many projects were begun that required years to complete. All the earlier estimates were made when construction costs were low and usually the first part of the land settled came in under a low construction cost; when years later additional lands were irrigated, higher prices made costs greater and the next unit thrown open was at a higher cost than the original estimate and higher than the settlers on the settled part of the project were paying.

With every increase in cost there had to be a boost in prices of water right so as to avoid losses. This has resulted in great inequality of burdens on the same project. Discontent on the part of settlers carrying the larger costs was inevitable and it has created a difficult and embarrassing situation for those in charge.

ONE reason why settlers on projects that should be prosperous are not meeting their payments to the government is the fact that they owe private debts bearing a high rate of interest that take all the money they can spare from the operation of their farms and supporting their families. Not only is it to their interest to pay the debt that bears interest and postpone their debt that bears no interest, but great pressure is exerted on them to keep their money at home—let the government wait.

Many of these settlers' debts are due to a speculative inflation of land prices, which occurred on nearly all of these projects in the early stages of development. The generous terms of payment for water rights by the government made this a fruitful field for the land salesman, who would point out that all one had to pay on the water right was a low rate of interest for 20 years and then his payments would end, and it was often whispered to the settlers that if they stood together they could succeed in having payments postponed or written off en-

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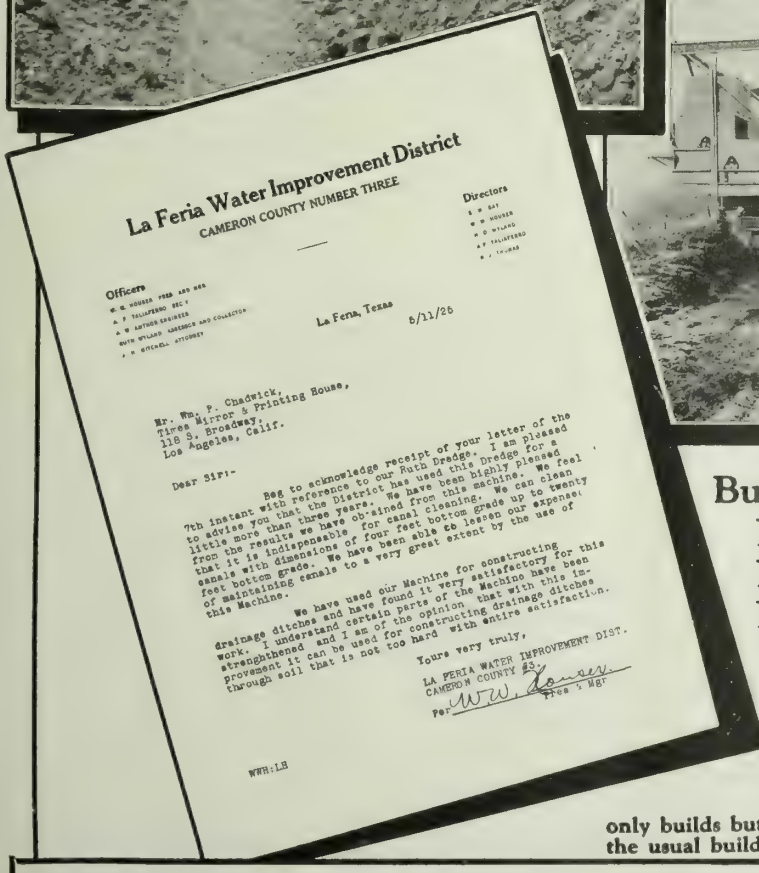

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CAMERON COUNTY NUMBER THREE

Directors

Officers

La Feria, Texas 6/11/26

Mr. Wm. P. Chadwick,
Times Mirror & Printing House,
116 S. Broadway,
Los Angeles, Calif.

Dear Sir:-

Beg to acknowledge receipt of your letter of the 7th instant with reference to our Ruth Dredge. I am pleased to advise you that the District has used this machine for a little more than three years. We have been highly pleased from the results we have obtained from this machine. We feel that it is indispensable for canal cleaning. We can clean canals with dimensions of four feet bottom grade up to twenty feet bottom grade. We have been able to lessen our expense of maintaining canals to a very great extent by the use of this Machine.

We have used our Machine for constructing drainage ditches and have found it very satisfactory for this work. I understand certain parts of the Machine have been strengthened and I am of the opinion that with this improvement it can be used for constructing drainage ditches through soil that is not too hard with entire satisfaction.

Yours very truly,

LA FERIA WATER IMPROVEMENT DIST. CAMERON COUNTY #3.

Per W. W. Pres & Mgr

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SUPER CRAWLER DREDGER

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tirely. When Secretary Work asked an officer of a settlers' organization why they were not doing more to meet their payments, the answer was that until the government collected its debt from France, it ought not to ask settlers to pay.

This does not mean that many settlers on these projects are not going through a distressing experience. They have suffered as farmers everywhere have suffered but their trouble today is not so much meeting project costs as the high interest rates and the payment of principal on their private debts.

THE remedy for this is not to make reclamation a credit agency but to try and work out some system for the refunding of their debts which bear eight and twelve per cent interest. Many of them now are overdue and should be converted into long time amortized loans bearing low interest rates. Financial and economic relief should come from some other sources than postponement of payment of expenses for operating canals.

Secretary Work has taken a decided stand in this matter. One of the projects that has never paid operating expenses is to be sold for what it will bring. Where it is known that water users are able to pay, they are being pressed to pay, in justice to struggling, deserving settlers who had paid, and, where there is a refusal to pay, suits are being brought to collect. An end has been brought to the demoralizing practice of issuing blanket moratoriums which only pile up the debt to be paid in the future, which lets the well-to-do and prosperous escape their obligations in order that relief may be extended to those who ought to have it.

Hereafter, if the view of Secretary Work prevails, the relief extended will be individual and will be confined to those who can show that they have made every effort to meet their obligations to the government.

ON some projects there must be an adjustment of payments and the writing off of part of the cost. It was the conclusion of the Fact Finding Commission that on some of the projects money has been spent which cannot be recovered and that this loss should be admitted and the records revised to show the exact situation. This does not mean that the project costs on the good lands will be reduced. The Frannie Division of the Shoshone Project or the east side of the Uncompahgre Project are illustrations of the need for adjustment. Here canals have been built to covtr large areas of unfertile land. On the Shoshone project 200 settlers have abandoned these farms. On the Uncompahgre project there are thousands of acres that are not being cultivated and never will be. The cost of the canals to cover these areas should be written off.

It is certain that the increased cost of everything will be reflected in the future cost of irrigation works. The estimates for water rights for four new projects included in last year's appropriation vary from $125 to $160 an acre. That is far higher than the actual costs on any of the old projects. Hereafter, the land will be classified and the cost of water rights, instead of being uniform, will vary on different classes of land because earning power varies. On the project where the average cost is $160, the cost of the water right for the best land may be between $175 and $200.

In order that Congress might understand what would likely happen if these projects were built, four economic boards were created to study conditions and make a report as to whether they were feasible. These boards reported that, in addition to the cost of the water right, the settlers who took up farms would have to expend from $100 to $125 an acre for clearing the brush, leveling the land, constructing fences and farm buildings, providing the minimum of livestock and equipment, and paying expenses until crops could be grown. In other words, the settlers would have to spend from $5,000 to $10,000 in order to make these farms going concerns.

ALL of these investigators recommended that there should be, on every project, someone who had practical knowledge of conditions, who would act as an advisor to the settlers, telling them how and where to carry on development, what crops to grow and where to find markets. That settlers should be required to have some capital and some experience.

It was recommended that there should be some credit agency from which advances could be made to pay a part of the development cost. The opinion of many of those present was that the time had come when the State should be called upon to make some investment and effort in a development which meant more to it than to the nation.

The state view prevailed and on the four projects referred to there is a requirement in the appropriation that the State must agree in a contract with the secretary to take charge of settlement, to lay out and plan the development of the farms, to furnsh practical advice and direction, and advance money to complete the improvement and equipment of farms. The indications are that they will comply with these conditions and that an era of cooperative development is before us.

Agricultural Engineers Meet in Los Angeles

Elect New Officers and Hear Papers on Various Phases of Farming Engineer's Work

The Pacific Coast section of the American Society of Agricultural Engineers met in May in Los Angeles with twenty-five members from various parts of California in attendance. The meeting was held at the Clark Hotel, and after a banquet, the association listened with keen interest to three papers delivered by members, dealing with various phases of the work of the agricultural engineer.

Professor David Weeks, of the Division of Rural Institutions, University of California, read a paper dealing with the need of a national reclamation policy based on sound economic considerations. The first part of his paper was a discussion of the general problem of reclamation, with reference to the experience of the past and the demands of the future, and this was supplemented by an illustrated talk on illustrative aspects of the Spanish Springs project, with which Mr. Weeks has had exceptional opportunity to become acquainted by virtue of his position on a special board of investigators appointed by the Secretary of the Interior.

Max E. Cook, farmstead engineer of the California Redwood Association, delivered a very practical paper on the construction of farm buildings, illustrating his points with photographic slides of typical structures designed to serve the farmer withe the maximum of economy and convenience.

Prof. B. D. Moses, Division of Agricultural Engineering, University of California, delivered a progress report on the activities of the California Committee on the Application of Electricty to Agrculture, which brought out in detail many of the things which that body is now accomplishing.

Officers of the section for the ensuing year were elected by the association as follows:

Chairman: Prof. Frank Adams, Division of Irrigation Investigation and Practice, University of California, cooperating with the United States Department of Agriculture, Davis, California.

Vice-Chairman: Max E. Cook, farmstead engineer, California Redwood Association, Los Angeles.

Secretary and Treasurer: Prof. L. J. Fletcher, head of the Division of Agricultural Engineering, University of California Farm School, Davis.

TEXT OF McNARY RECLAMATION BILL

IN AN article in another part of this issue, Senator Charles L. McNary, of Oregon, chairman of the committee on Irrigation and Reclamation in the United States Senate, tells of his conception of the need for a new, comprehensive, national policy for reclamation and of a plan which he feels convinced would meet that need in a wise, constructive way.

"I am sending you a copy of a bill which I have just had printed," writes Senator McNary, "which embodies, in a legislative way, my views on this subject."

The bill, which is given in full herewith, will be introduced by Senator McNary before the first session of the Sixty-ninth Congress, which convenes next December. It is a document which will repay earnest study and careful thought by all friends of irrigation and reclamation. The bill follows:

A BILL to encourage the development of the agricultural resources of the United States through Federal and State cooperation.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That when used in this Act—

(a) The term "Secretary" means the Secretary of the Interior.

(b) The term "district" means any district organized under the law of any State to provide for the reclamation of lands for agricultural and home-making purposes, with authority to issue bonds which shall be a general charge against all lands within the district and to contract with the United States under this Act as provided herein.

(c) The term "farm" means an area of land within a reclamation project sufficient in size, in the opinion of the Secretary, to support a family, but not exceeding one hundred and sixty acres of reclaimed land.

(d) The term "excess lands" means all lands in a single holding in excess of one established farm.

SEC. 2. That the Secretary is authorized to investigate the feasibility of reclaiming the lands within any district in any State under contract with the district. One-half the cost of investigation shall be advanced by the district and one-half by the United States. Such investigation shall cover full details concerning water supply, engineering and economic features, the cost of construction, land prices, and the probable cost of developing and settling the lands to be reclaimed. If upon such investigation the Secretary concludes that reclamation is feasible, written finding to that effect shall be made and submitted to Congress for consideration, with copies of reports and other data upon which such conclusion of feasibility is based. Upon authorization by Congress and the appropriation, in whole or in part, of funds therefor, the Secretary is authorized, under contract with the district, to construct the necessary works for the reclamation of the lands involved and operate and maintain the same so long as such operation and maintenance are necessary, in the opinion of the Secretary, to safeguard the interests of the government. The total cost of construction and of operation and maintenance, which shall include a just portion of overhead expenses, shall be paid by the district to the United States.

SEC. 3. That before construction of a project is commenced the sizes of the farms therein shall be established and agreements shall be made effectively subjecting not less than 80 per centum of the excess lands within the project to disposal by authority of the Secretary to settlers at prices and terms fixed in advance in such agreements. Such prices and terms shall be determined with the view of placing a bona fide and competent settler upon each farm of the project with the least possible delay.

SEC. 4. That when, in the opinion of the Secretary, a project has been fully completed and successfully operated for one season the Secretary shall fix the construction cost thereof, which shall include the total cost of investigation, the expense of selling district bonds under section 5, interest at not exceeding 5 per centum per annum upon all sums advanced by the United States in the construction thereof, and the cost of operating and maintaining the project to the date of fixing such cost. This total cost the district shall agree to pay to the United States within a period not exceeding forty years, with annual interest thereon at not exceeding 5 per centum per annum: *Provided,* That upon receipt by the United States from the proceeds of district bonds, as provided in section 5, of such total cost with interest, the obligation of the district to the United States for construction shall be satisfied: *Provided further,* That upon the receipt of such total cost the moneys advanced by the district for investigation of the project shall be returned to the district. So long as the government operates and maintains a project the district shall also pay to the United States annually, upon terms to be fixed by the Secretary, the total cost of operation and maintenance.

(*Continued on Page 53*)

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1. Financing Lands Under New Irrigation Projects

By B. J. SEGER

OWNERS of irrigated lands have come to realize that it is becoming increasingly more difficult to secure adequate loans on lands in irrigated sections. It is a well known fact that loan companies do not hesitate to loan one hundred dollars per acre on farm lands in the rain belt, while they will loan but twenty-five to forty dollars per acre on irrigated lands and, in many instances, will make no loans at all.

Farmers on irrigated lands need as much if not more capital to farm successfully than those in the east who raise corn and small grain. The fact that crops grown under irrigation are more certain and under good farming methods, produce larger yields than where crops depend on rain fall, does not seem to influence the loan companies to favor loans on irrigated lands. Steps should be taken to remedy the situation brought about by this handicap, to the end that definite plans may be inaugurated which will improve these conditions.

B. J. SEGER

Secretary-Treasurer of the North Platte Valley (Nebraska) Water Users' Association and of the Farmers' Irrigation District.

It is not the purpose of this paper to present a plan for securing loans which will enable the landowner who already is deeply in debt to increase his indebtedness, but to show, if possible, how adequate loans at a low rate of interest may be secured where it is not possible at the present time. I hope to make some suggestions from which may be evolved definite plans for securing adequate farm loans for irrigated lands and which will give relief to the landowner who is carrying a heavy burden of debt at a high rate of interest.

We will first consider the irrigation system of a new project. We will take it for granted that the system is well built, its headgates and wasteways are well constructed and in good repair, the water supply ample and sure. The land appraiser or agent who desires to make loans under an irrigation project and is guarding the interests of his company will carefully inspect the irrigation system.

After investigating the physical condition of the system, the appraiser would desire to know first, the amount of bonded or construction debt per acre against the lands; second, plan of payment—how much is required to be paid yearly per acre; third, he would ascertain if any effort is being made on the part of the Board of Directors of the District to collect taxes or to see that they are paid with reasonable promptness.

If bonds were semi-serial—serial after ten years—they should be changed to a straight serial bond, for the reason that a considerable saving in interest could be made and, further, the payments would not become too heavy to be paid out of returns from the land, as the debt could be spread over as many years as necessary to bring the yearly payments within easy reach of the farmer.

THERE would be several advantages to an irrigation district in issuing a serial bond. First, there would be a reasonable assurance that the bonded debt would be paid as the payments became due. Second, there would be a distinct saving in interest over the semi-serial type of bond. Third, with a strictly serial type of bond, the payments could be such that the land owner would be more certain of meeting them as they became due. The land owner would be in better position to secure a loan on his land for the reason that a loan company would be more willing to loan on lands that were not already overburdened with heavy water right charges or irrigation taxes.

With the irrigation district's finances arranged to the best advantage possible to the land owner, we are now ready to consider loans under *new* projects. It is a well known fact that it is very difficult to secure loans of any kinds on lands under a new irrigation project. If a loan is made, it is inadequate as a rule and usually bears a high rate of interest.

If a farmer on a new project is not able to secure a loan for a reasonable length of time, at a low rate of interest, for building his most necessary improvements and for the purchase of equipment and live stock, he will be greatly handicapped in getting his farming plant on a paying basis.

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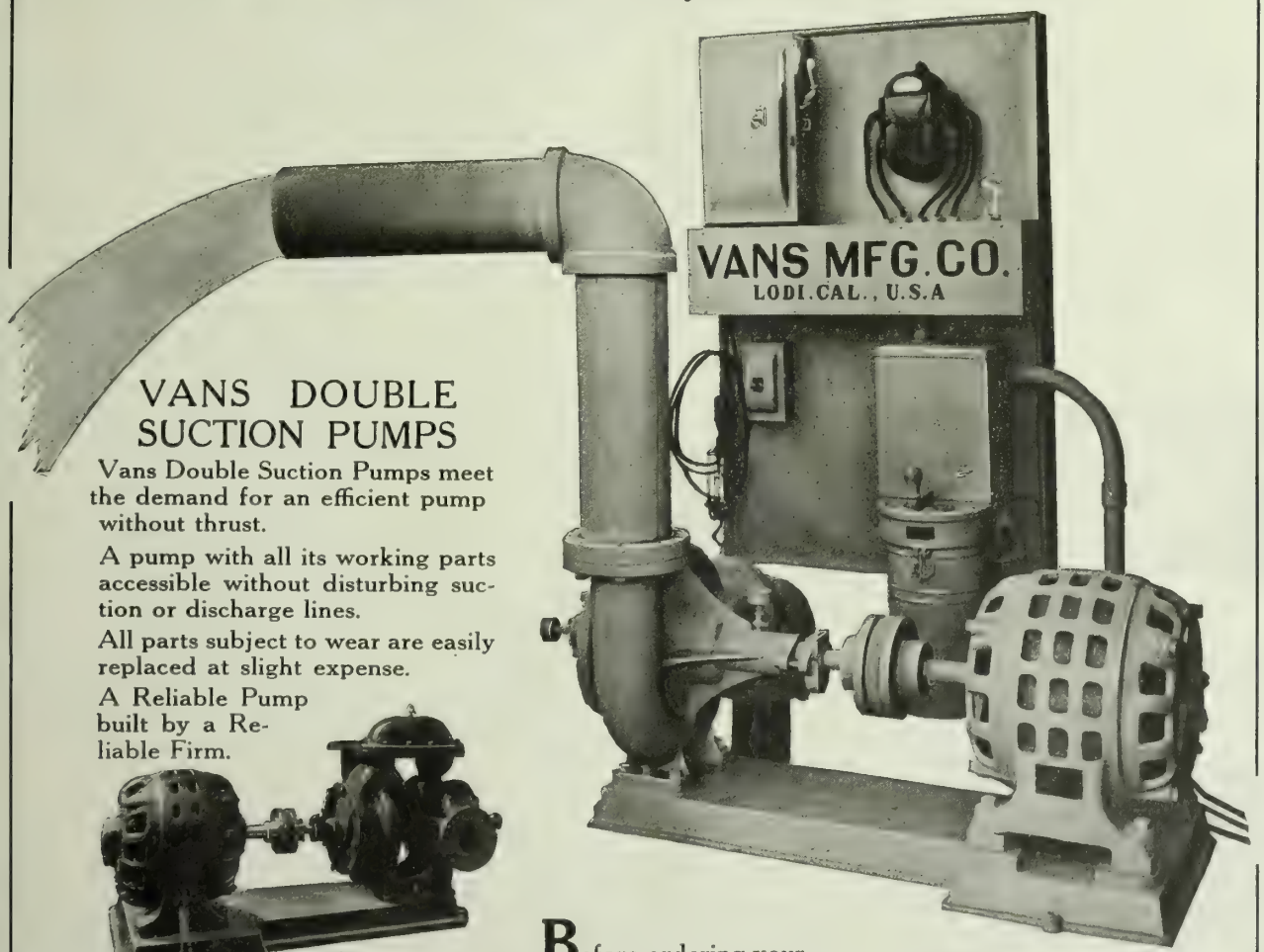

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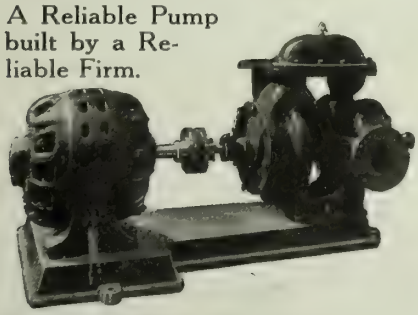

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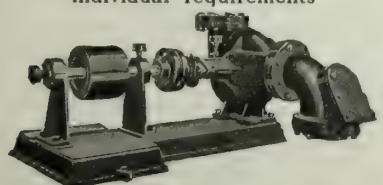

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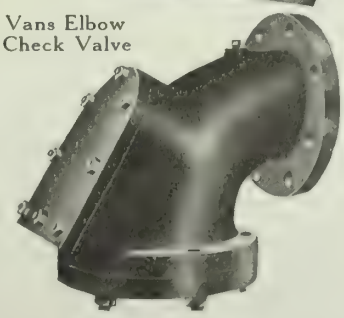

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Practically every farmer who buys land under an irrigation project has some cash and equipment at the start, but his funds are soon exhausted and usually he has not been in the community for a sufficient length of time to establish his personal credit. If he tries to borrow on his land from regular loan agencies, he seldom meets with success. The local bank, as a rule, is not in position to loan him money, in sufficient amounts on the security the individual farmer is able to give; nor can the banker make a loan to him for a sufficient length of time to give him opportunity to get his farming operations on a paying basis. How, then, can the irrigation farmer or land owner secure a loan for an amount which will allow him to purchase needed stock and equipment?

WE will take it for granted that the majority of landowners under an irrigation project, as described, came to the project with some cash and equipment. If all of the improvements, equipment, necessary farm implements, work horses and other stock owned by each farmer were pooled, the combined assets would form a basis for a strong cooperative association.

In a number of communities in Nebraska and other states, groups of farmers have organized Mutual Loan Associations for the purpose of purchasing dairy stock. Where properly organized, they have been successful. The amount of authorized capital stock depends on the size of the organization. The par value of one share is $100.00. Four kinds of stock are sold—paid up stock, partial payment stock, investment paid up stock and partial payment investment stock. After sufficient funds are secured from the sale of stock, money is then loaned at a low rate of interest to those desiring to purchase dairy stock. The cows purchased are given as security.

Such an association could be organized, on a somewhat larger scale, by a group of from one hundred to five hundred landowners. An association of this kind could be organized under the present laws of Nebraska, for example, if the name of the association included the word "Savings", such as: The Mutual Loan and Savings Association.

It would be feasible for land owners under new projects, and those landowners under one or more older projects, to organize such an association. In combining several projects, especially if they are comparatively small, it would be possible to provide sufficient funds to loan to the stockholders if funds from some outside source could be secured equal to the amount raised from the sale of stock of the association.

The United States Department of Agriculture recently issued a bulletin entitled "Irrigation District Operation and Finance", in which it was stated that two of our western states have assisted irrigation districts in those states by loaning the credit of the state, in the following manner: the State issues bonds which are sold, and the proceeds of the bonds are then loaned to the irrigation district. The district pays the interest on the bonds, and takes them up at the end of five or ten years.

Since this has been done in other states with good results, provision might be made whereby the state of Nebraska, let us say, or some other state where the plan has not yet been put into effect, would loan its credit in the same manner, to loan associations formed under irrigation projects for agricultural purposes, making it possible for the association to borrow an amount equal to the paid up stock of the organization. This would furnish sufficient funds with which to make loans. The amount loaned to the individual could be increased from year to year, as the funds for loan purposes increased. All loans to the members to be from one to three years with interest at the rate of 5 per cent to 6 per cent.

After the association had been organized for a few years, there would be funds returned from interest and loans paid which would enable the organization to have a revolving fund large enough for the needs of the members. There would be no limit to the possibilities and usefulness of such an organization, if properly managed.

THE advantage of such an organization would be, that all of the improvements, stock, farm equipment and credit of its members could be utilized to the fullest extent as security behind the stock issued. The expense would be small; all of the profit of the association would go to the members. The members, in turn, would be enabled to borrow money at a low rate of interest with which to purchase income producing stock and for the building of needed improvements. The better the farmer's equipment the greater his profits, which, in turn, would enable him to get on his feet financially in a comparatively short period of time.

A Mutual Loan organization in the community would not interfere with the regular banking business. In fact it would be of material help, for the reason that the association would take care of the long time loans, leaving the banks the thirty, sixty and ninety day loans. Since none but stockholders could take advantage of association loans, and only for agricultural purposes, there would

(*Continued on Page 49*)

A Word to Advertisers

Who Sell the Irrigation Market --including Allied Hydraulic Fields

THIS issue breaks new ground in the field of industrial journalism. Of MODERN IRRIGATION you will hear considerable, from this time on. In all the world there is no periodical like it; in all the United States no industry more important than that which it serves; none that has been more neglected, from the standpoint of development through sound merchandising and advertising, or that offers greater returns for the future.

Closely, indeed intimately, allied to irrigation is the great hydro-electric industry and the fields of municipal and industrial water supply. In many respects their interests are common interests—their problems mutual. Many of the engineers who lay out big irrigation projects are retained, in a consulting capacity, by municipal water systems and by hydro-electric interests. Because, in the West, the development of water supplies, and their conservation, presents a common problem, the publication will be followed closely by city engineers and water works superintendents as well as by executives and hydraulic engineers of the electric power companies. For it will contain much of helpful, practical value to them.

First of all, however, will it become the guide and manual of the irrigation field—a vast market with a total buying power greater, perhaps, than that of any one other industry; for in most sections of the West agriculture and irrigation are synonymous terms. By now, this issue is being read by men whose annual purchases aggregate millions. MODERN IRRIGATION is the logical and *only* medium offering direct coverage of the market which they represent.

The active cooperation of the leading men of the irrigation world, who will serve in an advisory capacity to the editors, stamp it as a publication of influence. As an advertising medium of the first water, its value will be quickly apparent. More and more, as each issue makes its appearance, will its pages become the recognized "Who's Who" of the equipment concerns which sell this field.

The publishers are preparing some intensely interesting memoranda of value to every advertiser who would like to sell more irrigation equipment. Letters or telegrams of inquiry will be answered promptly, and involve the sender in no obligation—other than intelligent consideration of the medium which already is the organized voice of the irrigation movement, and which is destined to become a real service institution to readers and advertisers alike.

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OVERHEAD IRRIGATION

MY CITRUS TREES GET ALL THEIR WATER FROM ABOVE

By F. H. MACPHERSON

IN ENTERING upon a discussion of the subject of overhead irrigation, as applied to citrus husbandry, I should like to have it understood that I do not pose as an expert, nor as one having had even a long experience in things agricultural. My trend of thought until I came to California was along entirely different lines. I had, however, for over ten years, dreamed of the time when it would be possible to retire from a rather strenuous business life to the quiet and sunshine of the wonderful West. In 1920 this became possible. For some years previously I had owned the ten-acre orange grove upon which I located on arrival in California, but as happens frequently with the "absentee landlord" I had paid very little attention to the grove, with the result that when I did come I found it in very poor condition; which is evidenced by the fact that I have removed over one hundred and fifty of the trees then in the grove replacing them with re-sets. Shortly after arrival, I began taking an interest in the grove, watching the various phases of citrus culture as each developed.

TWO TYPES OF HEADS. (ABOVE) REVOLVING SPRAYS SET IN ALTERNATE ROWS, ONE TO EVERY OTHER TREE; (BELOW) TRYING OUT A SYSTEM OF ONE HEAD TO EACH TREE.

I was immediately impressed with the seeming inadequacy of the irrigating methods generally practiced, and I started experimenting along lines which occurred to me as being more nearly nature's way of supplying moisture. I started out in 1921 with one head (of spraying equipment) coupled to my domestic water line. I followed this with five other heads, later adding eight more, until I had thirteen heads in operation by August, 1922. I made note from time to time of the seemingly advantages of overhead irrigation over the furrow method, and so fully convinced was I of these advantages that I decided upon equipping the entire grove with the overhead system. This was completed by November, 1922. A little while before I had decided upon the complete installation, I learned, for the first time, that two or three other citrus growers had antedated me, and were irrigating their groves with sprinklers almost identical in type with those I had been trying out, but portable, while mine were stationary. I mention this in fairness to others who had been working along similar lines.

My entire grove has been under the over-head system of irrigation for two and one-half years, and the results have thus far been entirely satisfactory. It should always be remembered that the grove was in a very much run-down condition when I installed the over-head equipment, and that even yet I have not gotten the trees back to such a point of health and growth as would give the crop returns to which one would be entitled from trees as old as mine, had they been properly cared for from the start.

HERE, perhaps, will be the logical point in this article to enumerate the advantages which up to this time I have satisfied myself accrue to the user of the overhead method of irrigation:

1—The ability to get and to apply moisture, when and where, as shown by the soil auger, it is needed.

2—The fact that there is absolutely no loss of water during irrigation. None of this precious fluid escapes down the ditches by the roadside; or over into the neighbor's grove; or down through the soil at the upper and lower ends of the grove.

3—Loss of water by evaporation is reduced to a minimum, as all irrigation is done at night.

4—The fact that 100 per cent of the root area receives moisture, reasonably and evenly distributed.

5—A very considerable saving in the quantity of water required during the ordinary irrigation season.

6—No carrying of the silt from the upper to the lower end of the grove.

7—The keeping of the tree and leaves free from dust and dirt, greatly improving the appearance of the foliage and the quality of the fruit.

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DISTRIBUTES the water applied in the form of small drops just like a gentle rain—not in a mist that will be lost by evaporation or in a deluge that will wash the soil.

Gives a 100% distribution over the entire area irrigated. Apply an inch or less of "rain"; let it stand for a few hours and dig where you will and not a spoonful of dry earth can be located.

Requires less than half the water necessary for the ditch or furrow system where there is an immense waste on account of varying texture of soil and run-off.

Affords an immense saving in labor. Simply open the valves and let it "rain" on a section of one, five or ten acres for a few hours—then shut off and turn on another section. No furrowing needed in advance of irrigating.

Obviates the necessity of terracing and contour planting—even on the steepest hillsides. Trees can be planted square and every drop of water applied will soak in.

Prevents and disintegrates plow-sole—thus making sub-soiling and deep cultivation unnecessary.

Absolutely prevents damage from wind-burn. Moisture carried by the wind will entirely check evaporation from the leaves and fruit.

Saves the expense of spraying for red spider and other insects and by keeping the trees in a healthy condition will make all, or practically all, fumigation unnecessary.

Prevents June drop by eliminating the evaporation from the trees that causes it.

Gathers nitrogen from the air and forces downward distribution of nitrates and soluble parts of manure that have been applied near the surface. It also carries humus in solution below ploughed depth to all deep-lying roots.

We make complete guaranteed installations including pumping equipment for boosting machinery if desired or will sell you the necessary equipment, make your plans and superintend installation.

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8—Eliminating the necessity of deep plowing.

9—Elimination of plow sole.

10—Has eliminated to date, the necessity of spraying for red spider.

11—Forces downward distribution of nitrates and soluble parts of manure applied near surface. Carries humus in solution below plowed depth, to all deep-lying feeding roots.

12—A possible reduction in cost of fertilizer, as a result of the more thorough distribution and more efficient utilization thereof.

13—The elimination of June drop.

14—The washing off of very much of the "honey-dew" deposited upon the fruit as a result of black scale and aphis, thereby sending the fruit to the packing house in a very much cleaner condition than would be otherwise possible.

15—More uniform and earlier growth of cover crop.

16—Production, by natural means, of the deep, reddish-yellow fruit which packing house experts have for years been trying to produce, both by natural and by artificial means.

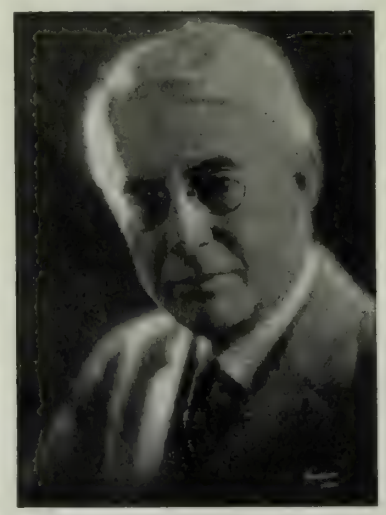
17—A very material saving of expense of furrowing, of labor in making connections with irrigation stands, of labor in irrigating and of cultivation after irrigating.

18—The ability to supply moisture to the tree and root system more nearly in nature's way in summer, and in winter as well, when there is a shortage of rainfall as during the winter just passed.

19—The prevention of damage from frost, at least down to a temperature of 25 degrees.

MOST of these advantages are so self-evident that no additional testimony in support of them is necessary. During the irrigation season, May 1st to November 1st, I used upon my 8½ acres 405,700 cubic feet of water, or 13.15 acre inches. A comparison with five of my neighbors covering 39 acres showed a total of 3,138.000 cubic feet of water, or 20.75 acre inches used by them, being over 50 per cent more water used by the furrowing method than by the overhead method of irrigation. Consider further that in the case of irrigation by overhead sprinkling 100 per cent of the root area received moisture, while by the furrow method possibly not to exceed 60 per cent to 70 per cent of the root area was reached. The soil is of substantially the same type throughout the area under comparison. A natural query just here would be: Did my grove receive as much water as it should have had? The reply is that the moisture conditions were excellent throughout the entire season, as can readily be attested by between 400 and 500 citrus growers in Southern California who visited the grove during the irrigation season, who saw soil-auger tests made, and who also had opportunities of noting the general condition of the grove.

Perhaps I ought to say here that the soil in this neighborhood is of a comparatively light type. I have had no experience with the heavier soils, but it occurs to me that if the owner of the grove with the heavier soil will provide himself with sprinkling equipment which will spread the water over the grove in smaller drops, and possibly at a slower rate of speed, giving the moisture an opportunity to seep in, the same results can be obtained as in the case of the lighter soils.



F. H. MACPHERSON, writer of the accompanying article, is an overhead irrigation "fan," who has probably done more than any other one grower of citrus fruits to give the over-head theory a practical demonstration under actual growing conditions, on his eight and one-half acre ranch, "Sunny Slope," at San Gabriel, California.

Mr. MacPherson came to California five years ago with the intention of "seeking retirement." His fifty-nine years of business life in the east had been full and varied, including successful experience as a publisher, accountant and financier, in addition to which he was connected with several of the large paper-manufacturing firms of the east in executive capacity. In addition to his horticultural interests, he is now a director of a large number of financial, business and civic organizations of Southern California, and is president of the Sunny Slope Water Company.

Turning on two valves down in the center of the grove constitutes all the hard work there is connected with the actual irrigation under this method. Our irrigation is all done at night, but late in the afternoon of the day preceding the system is turned on, and the heads that for any reason are found not to be working perfectly are inspected and the cause of the trouble removed. As soon as the moisture conditions permit, the grove is cultivated in order that it may hold the moisture content to the best advantage. The cost of cultivation during the irrigation season of 1924 did not exceed $20.00 per acre. We are doing some experimenting with different methods of tillage and may have some rather interesting reports to make thereon at a later date.

McNary on Reclamation

(*Continued from Page 18*)

and the money covered into the Treasury of the United States, to be again advanced to other projects. By a scheme of a fund revolving in character, a limit would be placed upon the amount of money to be advanced by the government. Private initiative would be called upon to carry the projects through to a successful development and private capital would find a new and inviting field of investment, thereby relieving the government of a continued burden. The whole of the sums advanced would be returned to the Treasury of the United States, assuring the government against loss and relieving it from a permanent contribution in the development of its resources.

A bill embodying provisions similar to the suggestion briefly outlined was introduced by me in the Senate a few years ago, and by Congressman Smith of Idaho in the House. The bill passed the Senate, but was not pressed in the House for the reason that the depression which faced agriculuture throughout the country did not seem to offer an opportunity calculated to insure its passage.

Inasmuch as the Colorado River project is pressing for government action, and others of kindred nature are being considered, it seems appropriate that the Congress should again consider a plan which contemplates the inclusion of all reclamation, wheresoever located in the states, free from the appeal of special appropriation for particular projects.

Some plan of development of the nation's agricultural and water resources should be conceived and written into law so that the advocates of development and the patrons of investments may know in what manner and to what extent Federal aid and encouragement may be expected. Otherwise, and in the absence of a national policy, the Congress will be called upon interminably to legislate in a field rich in rivalry and poor in a policy designed to insure the Treasury against exploitation and the country against overexpansion of our latent resources.

Adequate Farm Loans

(*Conitnued from Page 44*)

still be a large field for the services of the local banker.

With such associations on the projects to take care of the needs of the farmer as to loans for the first few years, he would soon be established on a good financial basis. Members of such an organization would have no trouble in securing real estate loans from the Federal Land Bank or from the Joint Stock Land Bank, if needed. The mere fact that such land owners operated a successful loan organization among themselves, would give the loan companies confidence in the individual members and in their ultimate success.

It is quite certain that loans secured from the Federal Land Bank will be more satisfactory as to the amounts loaned when irrigation projects and the landowners under them realize the importance of getting their indebtedness on a basis which will not be burdensome to them, and, therefore, not so hazardous for the loan company.

THE Joint Stock Land Bank has not yet made any loans on irrigated lands in Nebraska. As to other states where irrigation is practiced, I cannot say with any certainty. No doubt this bank will make loans on irrigated lands just as soon as a project and the landowners under it can demonstrate their ability to pay their obligations when due. The rules of this bank permit it to make loans to landowners whether they live on the land or not; but the owner must live in the vicinity of the land so that he can give the farm his personal supervision.

Both of the loan agencies mentioned make farm loans at a low rate of interest on the amortized plan for repayment. After a number of years of experience, this plan for repayment is found to be the most satisfactory. This kind of loan seems to be the best for the land owner for the reason that the yearly payments are not excessive, and a small part of the principal is paid each year.

Dr. Elwood Mead, Commissioner of Reclamation, has the following to say regarding the financing of farmers under irrigation projects:

"In other countries where irrigation works are built by the government, provision is made for helping the settler prepare his land for irrigation and improving and equipping his farm. This is regarded as much a part of reclamation financing as providing the money to build the canals and laterals and reservoirs. Aid of this kind is given by Italy, Egypt, India and different Australian States,

(*Continued on Page 52*)

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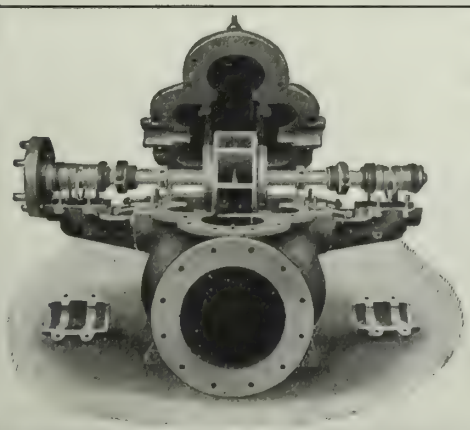

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SURVEY *of* IRRIGATION DEVELOPMENT

As Shown by Official Records of the Month -- Local, State, and Governmental

NEW PROJECTS AND DEVELOPMENTS CONTEMPLATED

AMONG the permits to appropriate water issued by the Department of Public Works, Division of Water Rights of California during the month of May, 1925 were those listed as follows:

Permit No. 2073, Application No. 3699 (Tulare County)—Issued to C. M. Jones, W. W. Slayden, Porterville, Calif., May 6, 1925, for 24 cubic feet per second from Tule River in Sec. 14, T 21 S, R 29 E, for power purposes in Sec. 15, proposes to develop 183 T.H.P. Estimated cost $15,000.00.

Permit No. 2074, Application No. 4242 (Del Norte County)—Issued to E. F. Raymond and Sons, Crescent City, Calif., May 6, 1925, for 0.008 cubic foot per second from an unnamed gulch in Sec. 9, T 17 N, R 3 E, H. M., for irrigation purposes in Sec. 8. Estimated cost $350.00.

Permit No. 2075, Application No. 1611 (Sutter County) Issued to D. W. Carmichael, Sacramento, Calif., May 7, 1925, for 28.36 cubic feet per second from Feather River in Sec. 1, T 12 N, R 3 E, M.D.M.. for irrigation of 1593.03 acres near point of diversion. Estimated cost $30,000.00.

Permit No. 2076, Application No. 4218 (Yolo County)—Issued to Holland Land Co. et al, San Francisco, Calif., May 7, 1925, for 35 cubic feet per second from West Cut of Reclamation District No. 999 in Secs. 33 and 21, T 6 N, R 3 E, M.D.M. for irrigation of 2800 acres near point of diversion. Estimated cost $10,000.00.

Permit No. 2077, Application No. 3290 (Sutter County)—Issued to P. J. Hiatt, Woodland, Calif., May 8, 1925, for 15.45 cubic feet per second from Sacramento River in Sec. 12, T 12 N, R 1 E, for irrigation of 1,073.10 acres near point of diversion. Estimated cost $15,000.00.

Permt No. 2079, Application No. 4085 (San Bernardino County)—Issued to A. I. Rouda, Los Angeles, California, May 15, 1925, for 0.025 cubic foot per second from an unnamed spring in Sec. 9, T 2 N, R 1 W, for irrigation of 40 acres in Sec. 9. Estimated cost $2,500.00.

Permit No. 2080, Application No. 4081 (Calaveras County)—Issued to Anten Pozar, Angels Camp, Calif., May 16, 1925, for 0.05 cubic feet per second from a spring in Sec. 22, T 4 N, R 13 E, for domestic use and irrigation of 10 acres in Sec. 27. Estimated cost $500.00.

Permit No. 2081, Application No. 4494 (Nevada County)—Issued to W. H. Griffith and F. M. Ray, Nevada City, California, May 19, 1925, for 136.24 acre feet per annum from Rock Creek in Sec. 25, T 17 N, R 8 E, for fish culture and recreational purposes in Sec. 25. Estimated cost $2,500.00.

Permit No. 2082, Application No. 1270 (Nevada County)—Issued to Nevada Irrigation District, Grass Valley, Calif., May 19, 1925, for 500 cubic feet per second and 65,000 acre feet per annum from Canyon, Texas, Fall, South Fork Fall Creeks and South Fork Yuba River, in Nevada County, for irrigation of 208,000 acres in Nevada Irrigation District. Estimated cost $2,856,460.00. South Fork of Midale Yuba River in Sec. 28, T 19 N, R 12 E, M.D.M. for power purposes in Sec. 16. Proposes to develop 6136 T.H.P. Estimated cost $75,00000.

Permit No. 2084, Application No. 2075 (Nevada County)—Issued to Nevada Irrigation District, Grass Valley, Calif., May 19, 1925, for 75,000 acre feet per annum from Mddle Fork Yuba River in Sec. 11, T 19 N, R 12 E, for power purposes in Sec. 16. Proposes to develop 12,927 T.H.P.

Permit No. 2085, Application No. 2276 (Nevada County)—Issued to Nevada Irrigation District, Grass Valley, Calif., May 19, 1925, for 75,000 acre feet per annum from Middle Fork of Yuba River in Sec. 5, T 18 N, R 12 E, for irrigation of 208,000 acres in Nevada Irrigation District.

Permit No. 2086, Application No. 2277 (Nevada County)—Issued to Nevada Irrigation District, Grass Valley, California, May 19, 1925, for 5,000 acre feet per annum from South Fork of Middle Fork of Yuba River in Sec. 5, T 18 N, R 12 E, for irrigation of 208,000 acres in Nevada Irrigation District.

Permit No. 2087, Application No. 2372 (Nevada County)—Issued to Nevada Irrigation District, Grass Valley, California, May 19, 1925, for 300 cubic feet per second and 65,000 acre feet per annum from Canyon, Texas, Fall and South Branch of Fall Creek in Nevada County for power purposes in Sec. 16. Proposes to develop 12,927 T.H.P.

Permit No. 2088, Application No. 2373 (Nevada County)—Issued to Nevada Irrigation District, Grass Valley, California, May 19, 1925, for 150 cubic feet per second and 12,500 acre feet per annum from South Wolf Creek in Section 25, T 15 N, R 8 E, for irrigation of 208,000 acres in Nevada Irrigation District.

Permit No. 2089, Application No. 2881 (Placer and Yuba Counties)—Issued to Camp Far West Irrigation District, Auburn, Calif., May 20, 1925, for 10,000 acre feet per annum from Bear River in Secs. 20 and 21, T 14 N, R 6 E, for irrigation of 4,102.37 acres near point of diversion. Estimated cost $125,000.

Permit No. 2090, Application No. 3843 (Placer and Yuba Counties)—Issued to Camp Far West Irrigation District, Auburn, California, May 20, 1925, for 50 cubic feet per second from Bear River in Secs. 20 and 21, T 14 N, R 6 E, for irrigation of 4,102.37 acres near point of diversion.

Permit No. 2091, Application No. 4105 (Sutter County)—Issued to Thomas J. Johnson et al, Sacramento, Calif., May 20, 1925, for 2.4 cubic feet per second from Feather River in Sec. 4, T 11 N, R 3 E, for irrigation of 192 acres near point of diversion.

Permit No. 2092, Application No. 4084 (Riverside County)—Issued to Western Savings Bank, Long Beach, Calif., May 20, 1925, for 0.2 cubic foot per second from an unnamed canyon in Sec. 24, T 6 S, R 5 W, for domestic use in Sec. 24.

Permit No. 2093, Application No. 3974 (Siskiyou County)—Issued to J. O. McBroom et al, Cecilville, Calif., May 22, 1925, for 37.5 cubic feet per second from Cecil Creek in Sec. 32, T 38 N, R 11 W, for mining purposes. Estimated cost $4,000.

Permit No. 2097, Application No. 4189 (San Bernardino County)—Issued to Giacomo Abbona, Chino, Calif., May 25, 1925, for .05 cubic feet per second and 6.14 acre feet per annum from an unnamed spring in Sec. 20, T 2 S, R 8 W, for irrigation of 13 acres in Sec. 20.

Permit No. 2098, Application No. 4351 (Yolo County)—Issued to Manuel Rose, Sacramento, Calif., May 25, 1925, for 1.25 cubic feet per second from Sacramento River in Sec. 2, T 10 N, R 3 E, for irrigation of 100 acres near point of diversion. Estimated cost $1,000.00.

Permit No. 2099, Application No. 4349 (Yolo County)—Issued to H. T. Silvius, Sacramento, California, May 27, 1925, for 1.25 cubic feet per second from Sacramento River in Sec. 11, T 10 N, R 3 E, for irrigation of 100 acres in Secs 10 and 11. Estimated cost $2,000.00.

Permit No. 2100, Application No. 2100 (Amador County)—Issued to J. W. Preston, Jr., San Francisco, Calif., May 27, 1925, for 350 cubic feet per second and 60,000 acre feet per annum from North Fork Mokelumne River in Sec. 33, T 8 N, R 16 E, for power purposes in Sec. 24, T 7 N, R 13 E. Proposes to develop 49,597 T.H.P. Estimated cost $6,000,000.

Permit No. 2101, Application No. 2548 (Amador County)—Issued to J. W. Preston, Jr., of San Francisco, California, May 27, 1925, for 350 cubic feet per second from Cole and Beaver Creeks and Bear River in Sec. 5, T 7 N, R 16 E, and Secs. 2 and 11, T 7 N, R 15 E, for power purposes in Sec. 24, T 7 N, R 13 E. Proposes to develop 49,597 T.H.P.

Permit No. 2102, Application No. 2996 (Amador County)—Issued to J. W. Preston, Jr., San Francisco, California, May 27, 1925, for 225 cubic feet per second from North Fork of Mokelumne River in Sec. 24, T 7 N, R 13 E, for power purposes in Sec. 32, T 6 N, R 12 E. Proposes to develop 37,483 T.H.P. Estimated cost $250,000.

Permit No. 2104, Application No. 1081 (Calaveras and Tuolumne Counties)—Issued to Oakdale and South San Joaquin Irrigation Districts, Oakdale and Manteca, Calif., May 29, 1925, for 96,195 acre feet per annum from Stanislaus River in Sec. 11, T 1 N, R 13 E, for irrigation of 145,358 acres near point of diversion. Estimated cost $2,000,000.00.

Permit No. 2105, Application No. 2460 (Calaveras and Tuolumne Counties)—Issued to Oakdale and South San Joaquin Irrigation Districts, Oakdale and Manteca, Calif., May 29, 1925, for 2000 cubic feet per

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second and 150,000 acre feet per annum from Stanislaus River in Sec. 11, T 1 N, R 13 E, for power purposes in Sec. 10. Proposes to develop 53,409 T.H.P. Estimated cost $2,000,000.

Permit No. 2106, Application No. 3091 (Calaveras and Tuolumne Counties)—Issued to Oakdale and South San Joaquin Irrigation Districts, Oakdale and Manteca, Calif., May 29, 1925, for 25,704 acre feet per annum from Stanislaus River in Sec. 11, T 1 N, R 13 E for irrigation of 145,358 acres near point of diversion.

Permit No. 2107, Application No. 4122 (Plumas County)—Issued to Ellen McMann et al, Wonderland, Calif., May 29, 1925, for 0.37 cubic foot per second from ings Creek and Cold Spring in Sec. 19, T 30 N, R 6 E, for domestic use and irrigation of 30 acres in Sec. 30. Estimated cost $50.00.

Permit No. 2108, Application No. 4167 (San Diego County)—Issued to Edward R. Burt, San Felipe Valley, Calif., May 29, 1925, for 12 acre feet from an unnamed wash in Sec. 2, T 13 S, R 5 E, for domestic use and irrigation of 5 acres near point of diversion. Estimated cost $500.00.

Permit No. 2109, Application No. 4419 (Los Angeles County)—Issued to Camp McClellan Improvement Co., Los Angeles, Calif., May 29, 1925, for 0.02 cubic foot per second from spring near source of Moscal Creek in Sec. 2, T 3 N, R 8 W, for domestic purposes in Sec. 35. Estimated cost $12,200.00.

Power Developments

The Federal Power Commission has recently authorized the issuance of the following licenses and permits, for projects in the irrigation country:

Project No. 103—To Messrs. Pattee, Bernhard and Ross, of Oakdale and San Francisco, Calif., and Astoria, Ore., respectively, a premilinary permit for 18 months for a power project located on the North Fork of Stanislaus River, in Tuolumne and Calaveras Counties, Calif. The proposed development will consist of a large storage reservoir having a capacity of 32,000 acre feet to be known as the Ramsey reservoir, and a conduit conveying water from a point about a mile below the reservoir to a power house located about 11 miles downstream. The estimated installed capacity is 5,000 horsepower.

Project No. 514—To Mr. Stephen E. Kieffer of San Francisco, Calif., a preliminary permit for 18 months for a power project in the Cosumnes River, in Amador and Eldorado Counties, Calif. It is proposed to construct a dam about 300 ft. high, forming a reservoir of 470,000 acre-feet capacity and to discharge the water from the reservoir through a power house to be located at a point lower down on the river, thereafter using the water for irrigation, domestic and municipal purposes for lands and cities in the Sacramento Valley west of the dam in addition to the development of power.

Project No. 527—To the Ventura Power Corporation of San Francisco, Calif., a preliminary permit for 18 months for a project located in Ventura and Los Angeles Counties, Calif. This project includes a series of power developments on Piru Creek involving the construction of two dams and storage reservoirs and three power houses with conduits leading to the latter. The aggregate power capacity of these sites is estimated to be 6,000 horsepower. It is expected that the power to be developed will be sold to public-utility companies in Southern California, and that a certain amount of the water will be used for the irrigation of lands below the project.

Project No. 121—(James B. Girand): The commission voted, since the consideration of the project for power development at Diamond Creek on the Colorado River, Arizona, has been intimately associated with the terms of the pending pact between the states of Wyoming, Colorado, New Mexico, Arizona, and California, which Arizona has refused to ratify and to which California proposes stipulations, and since a hearing has been demanded by protestants to the issuance of the license from the upper reaches of the Colorado, that such hearing be granted them, to be held in September next, in this city. It was voted, also, that unless adequate reasons are then presented against the issuance of the license, it is the thought of the Commission that a license shall then be granted.

New Incorporations

The following new water companies have been incorporated in California during the last month for which official records are available:

No. 114055—CLUB LAND & WATER CO., (a California company). Directors: M. C. Parker, F. E. Young, R. J. Hopper, all of Los Angeles, (each 1 share). Date of filing, May 6, 1925. Place of business, Los Angeles. Capital stock, $100,000. Par value, $100. Amount subscribed, $3000.

Purposes—"To develop and produce water by sinking wells for irrigation, also for creating ponds and artificial lakes to be used for irrigation and in connection with sporting, hunting, fishing and pleasure clubs and to create hunting grounds."

Articles filed by Dryer, Castle & Hartke, 615 Van Nuys building, Los Angeles.

No. 114087—SOUTH SIDE WATER CO., (a California company). Directors: A. C. Philpott, V. E. Bonham, A. J. Dutton, A. J. Bresnahan, O. V. Miller, all of Pomona, (each 1 share). Date of filing, May 8, 1925. Place of business, Pomona. Capital stock, $10,000. Par value, $10. Amount subscribed, $50.

Purposes—"To maintain and operate wells, pumps and reservoirs and pipe lines and to distribute water to its stockholders for irrigation and domestic purposes."

Articles filed by R. K. Pitzer, 324 Investment Building, Pomona.

No. 114122—H. J. S. MUTUAL WATER CO., (a California company). Directors: Jas. B. Smith, Santa Ana; Otho P. Jones, Santa Ana; David Henderson, R. F. D. No. 1, Box 204, Compton, (each 1 share). Date of filing, May 11, 1925. Place of business, Compton. Capital stock, $2055. Par value, $15. Amount subscribed, $45.

Purposes—"To supply water to its stockholders without profit and at cost within the County of Los Angeles for irrigation and domestic use."

Articles filed by Scarborough, Forgy & Reinhaus, Santa Ana.

No. 114169—MIRAFLORES MUTUAL WATER CO., (a California company). Directors: Reba Dunlop Osborn, John Passmore Osborn, R. F. D. No. 4, Box 101, Anaheim; Robt. L. Gambill, R. F. D. No. 4, Anaheim; (each 1 share). Date of filing, May 14, 1925. Place of business, Anaheim. Capital stock, $7,800. Par value, $50. Amount subscribed, $150.

Purposes—"To supply water to stockholders for domestic and irrigation use within the county of Orange."

Articles filed by Scarborough, Forgy & Reinhaus, 204 First National Bank Building, Santa Ana.

No. 114333—HAPPY VALLEY WATER COMPANY, (a California company). Directors: Wm. Plotts, Whittier; F. L. Alexander, St. Helena; Wm. B. Nicholl, Applegate; J. H. Brown, Olinda; J. J. McCrory, Olinda, (each 10 shares). Date of filing, May 26, 1925. Place of business, Olinda, Shasta County. Capital stock, $1,120,000. Par value, $1. Amount subscribed, $50.

Purposes—"To take over the assets of the Happy Valley Irrigation District and to carry out their plans of selling water for domestic and irrigation use to its stockholders."

Articles filed by Carr & Kennedy, attorneys, Redding.

No. 114350—H. C. FERTIG MUTUAL WATER CO., (a California company). Directors: H. C. Fertig, Los Angeles; Nelle T. Fertig, Los Angeles; John E. Jones, Palmdale, (each 1 share). Date of filing, May 27, 1925. Place of business, Los Angeles. Capital stock, $48,000. Par value, $100. Amount subscribed, $300.

Purposes—"To supply stockholders only for domestic and irrigation use."

Articles filed by Jesse F. Waterman, 424 Wilcox Building, Los Angeles.

Adequate Farm Loans

(*Concluded from Page 49*)

and South Africa. It is also a kind of aid given by all progressive European countries in helping poor men to buy and improve farms. The omission of this feature in the Reclamation Act should be corrected to bring us into line with the experience of other irrigated countries and to relieve credit conditions on existing projects. In these other countries, the estimates for the cost of improving and equipping farms are made with the same care as the estimates for building the irrigation works. In some cases the settler is required to have part of the money needed to carry out this development, and the state loans him what is lacking. The rate of interest on these loans varies from 3½ to 5½ per cent. The payments are amortized and they run all the way from three years, for the purchase of livestock, to twenty years for loans on buildings and other permanent improvements on the land. Usually these loans are made by some government official, who is appointed because of his agricultural knowledge and familiarity with conditions, and he combines with those functions that of being advisor to settlers to work out programs that will increase the farmer's income, and, along with low rates of interest, promote his prosperity."

In a recent article in the *Country Gentleman*, Dr. Mead has the following to say regarding the lack of interest which states in the arid west have toward lending assistance in the development of new projects:

"There has been a surprising indifference on the part of the arid states as to the method of settlement adopted, or the hard conditions met by the settlers.

The whole matter has been regarded an affair of the government. This is not as it should be. Nearly all of the arid states are now in a position to share in the financial responsibility. If they had such a share, there would be more careful scrutiny of proposed new projects and a more rapid and prosperous agricultural development."

Dr. Mead states further: "The advisory committee made two economic recommendations which ought to have the support of everyone. I will only quote the first one as follows: 'Project settlers are in need of relief from paying high interest rates on short time loans. They are often unable to borrow money with which to improve and equip their farms. A credit fund should be provided under competent control, from which settlers on the project can borrow money with which to make permanent improvements or to buy needed equipment and livestock. Loans for permanent improvements, secured by the land, should run not to exceed thirty years; loans for equipment and livestock, not to exceed five years. The rate of interest should be five per cent; payments of principal should be amortized; the making of loans should be at the discretion of the credit authorities.' "

I am fully convinced that it would be entirely feasible and proper to ask the state to not only lend its credit to enable irrigation farmers to secure working capital, but to show more interest in the agricultural problems of the farmer on irrigated lands. It is certain that the irrigation farmer, if he is to succeed, must be able to secure loans at a low rate of interest and for a reasonable length of time for repayment.

Text of McNary Bill

(*Concluded from Page 41*)

SEC. 5. That preceding any expenditure by the United States on account of construction of a project, bonds of the district equal in face value to the amount of the proposed expenditure shall be duly issued and delivered to the United States. If at any time it should appear to the Secretary that the original bond issue is insufficient to cover the cost of the proposed work, he may either curtail the work or require the district to issue additional bonds, and when the total cost of the completed project has been determined under section 4, all bonds issued in excess of such cost shall be canceled. The bonds shall be in form approved by the Secretary and shall run for a period not exceeding forty years, bear interest at a rate to be fixed by the Secretary not exceeding 5 per centum, payable annually, and be issued in denominations of $25, $50, $100, $500, and $1,000. These bonds shall be deposited with the Federal Farm Loan Board, and when the project cost is known and the value of all of the property of the district subject to assessment for the payment of the bonds shall reach twice the par value of the bonds as found by the said board, the board shall offer the bonds at public or private sale at not less than par under terms and conditions to be provided by rules and regulations to be made by said board. The moneys received from the sale of the bonds shall be credited upon the district contract. Prior to sale of the bonds the board shall collect all moneys due thereon, and the same shall likewise be credited upon the district contract.

SEC. 6. That unentered and unpatented arid and semi-arid lands of the United States susceptible of reclamation may be included in a district and may be subjected to the provisions of the Act of August 11, 1916 (Thirty-ninth Statutes, page 506), in accordance with the terms of said Act.

SEC. 7. That the United States may acquire lands hereunder for construction, but not for agricultural purposes: *Provided,* That the Secretary is authorized to accept, by gift, deed in trust, or otherwise, land within any district and dispose of the same upon terms and conditions to be agreed upon with the grantor or later fixed by the Secretary.

SEC. 8. That the Act of June 17, 1902 (Thirty-second Statutes, page 388), and all amendatory or supplementary Acts shall hereafter be known as the National Irrigation Law, and the fund provided for by said law shall hereafter be known as the National Irrigation Fund. This Act, and all amendatory or supplementary Acts, shall be known as the National Reclamation Law, and for the purpose of carrying out its provisions there is hereby established in the Treasury a fund to be known as the National Reclamation Fund. There is hereby authorized to be appropriated from any moneys in the Treasury not otherwise appropriated such sums as may be determined by Congress to be transferred from time to time to the National Reclamation Fund and appropriated upon estimates made by the Secretary for carrying out the provisions of this Act. All moneys received by the United States under this Act shall be paid into the National Reclamation Fund, and all moneys at any time in said fund shall be available for appropriation for the purposes of this Act.

SEC. 9. That the Secretary is hereby authorized to perform any and all acts and to make such rules and regulations as in his discretion may be necessary for carrying the provisions of this Act into full force and effect.

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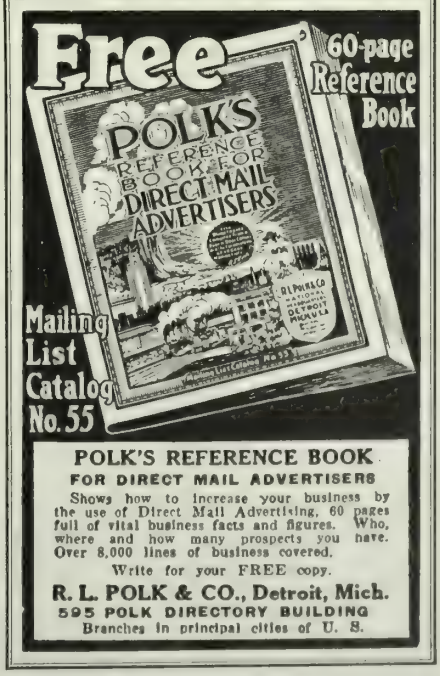

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AMONG OUR CONTRIBUTORS

Some Editorial Jottings About Current and Forthcoming Feature Articles Dealing With Practical Problems of Irrigation, and the Men Who Have Written Them

A BILL providing for a new national reclamation policy, supplementing the present reclamation act, to be introduced before the Sixty-ninth Congress by Senator McNary of Oregon, will provide one of the livest issues before reclamationists during the next few months. Without entering upon any discussion of the bill, MODERN IRRIGATION has felt it important to give it considerable space in this first issue.

An article by Senator McNary, explaining the principle and purpose of the bill, appears in the front editorial section. The proposed bill itself is printed in our department devoted to Reclamation.

Senator McNary was born on a farm near Salem, Oregon, which city is still his home, and throughout his life has been in close touch with the problems indigenous to the soil and water resources of the west. He has been a member of the United States Senate since 1917, and is chairman of the Senate Committee on Reclamation and Irrigation.

AS SUPERINTENDENT of the Orland Project, R. C. E. Weber, U. S. Bureau of Reclamation, is amply qualified to tell of the progress and success of that enterprise.

Mr. Weber has been identified with the Reclamation Bureau since 1909, and was assigned to the Orland project near the close of that year, serving as superintendent since 1921. He was born in Indiana, in 1885, and is a graduate of Purdue University, School of Civil Engineering. He has had a very creditable career of engineering experience, first in railroad work and later with the United States Forest Service, and the Geological Survey, Technologic Branch.

He has written numerous technical articles for various publications dealing with the construction features of the Orland project.

WHEN a man is in daily contact with the concrete problems of managing an irrigation district or water company, his remarks on the subject are apt to be full of real meat for others engaged in the same line of work. Richard Bard, president of a successful California company, writes a helpful article about some mutual water company problems and how they are being met in his organization, under the department heading of "Irrigation Management."

Mr. Bard is a well known agriculturist on a large scale in Southern California, who has made an enviable reputation in many of the varied departments of modern ranching. The pure-blooded, prize-winning livestock of the Berylwood Ranch, of which Mr. Bard is the active head, is known wherever good animals are appreciated. Mr. Bard is also general manager of the Berylwood Investment Company of Hueneme.

FREDERICK S. MYRTLE, who writes on the relation of electricity and public utilities to the irrigation movement, is editor of *Pacific Service Magazine*, published by the Pacific Gas & Electric Company, one of the leading power companies of the west and one of the world's largest hydro-electric institutions.

Mr. Myrtle is a former newspaper man, who has a record of exceptional service on Hearst publications, and for a number of years has been doing magazine and feature work for the "P. G. & E."

ELWOOD MEAD needs no introduction to an irrigation audience. His position as Commissioner of Reclamation assures any utterance from him a careful reading. in his article on the present status and outlook for reclamation, in this issue, he gives the attitude of the head of the service toward the past, the present, and the future of the national reclamation policy.

A. L. SONDEREGGER, who writes on "The Water Problems of the Valley of Southern California," deals with a subject upon which he is ably qualified to speak. As a consulting engineer, he has specialized in hydraulic engineering in Southern California including municipal water supply and irrigation, since 1906.

Mr. Sonderegger has acted as consulting engineer for a number of cities in Southern California, and for several years was consulting engineer for the receiver of the California Development Company (predecessor to the present Imperial Irrigation District). He has aso been prominent in ground-water litigation and has made extensive studies of groundwater supply, flood control and conservation. He served as a member of the Board of Engineers appointed by the City of Los Angeles in 1924 to report on the available water supply for the city. Mr. Sonderegger has to his credit a large number of technical papers on ground water and flood control.

He is a graduate of the Swiss Institute of Technology at Zurich, a member of the American Society of Civil Engineers and a certified member of the American Association of Engineers. He is also a member of the Board of Editorial Advisors of MODERN IRRIGATION.

B. J. SEGER, who writes on "Adequate Farm Loans for Irrigated Lands," is secretary and treasurer of the North Platte Valley Water Users Association, and of the Farmers' Irrigation District, with headquarters at Scottsbluff, Nebraska. He understands "from the ground up" the problems of which he writes, for he homesteaded under the government project in the North Platte Valley in 1906 and has been an executive of the Water Users' Association for the past fifteen years. This organization includes 1,325 members, and the Farmers' Irrigation District is comprised by 700 land owners.

Mr. Seger has been prominent in the financial and legislative affairs of irrigation in his state for many years. As financial manager of the Farmers' Irrigation District he has secured funds through the sale of warrants and the negotiation of loans to the amount of $1,094,000.00; and as a member of the legislative committee of the state irrigation association has assisted in securing the enactment of a number of progressive irrigation laws, including that enacted by the last session of the Nebraska legislature, which provides that an irrigation district may issue serial bonds to be repaid over a period of fifty years. The new law also provides for funding all indebtedness of the district into a single bond issue.

Mr. Seger's article is based on a paper recently given before the Nebraska State Irrigation Association. The first part of the article, dealing with loans under a new irrigation project, appears in this issue. A discussion of loans under old established projects has been reserved for a later number.

CALIFORNIA irrigators have long been exercised over the poor facilities for display accorded to manufacturers of and dealers in irrigation equipment at the state fair. In the August issue of MODERN IRRIGATION, C. A. Utley, secretary and first president of the Western Irrigation Equipment Association, will discuss this state of affairs in an entertaining and humorous article—which, nevertheless, deals with a subject of genuine importance. Look for "Under the Tattered Canvas" in the next issue; and we shall be greatly surprised if you do not concur heartily with the conclusion adduced therein by Mr. Utley.

THE Portand Cement Association is a national organization—one of several progressive trade associations which have recognized the worth of a service policy based on extending the maximum of gratuitous assistance to agriculturists and to all others who comprise its present and its prospective customers. J. E. Jellick, southwestern district engineer of this organization, has been able, in his article on the use of concrete in irrigation, merely to scratch the surface of this broad subject, and one of the principal benefits which the reader may derive therefrom is the specific information given in regard to the various technical publications issued by the Association, which are available for his use upon request.

Mr. Jellick is in charge of the district comprising Southern California and Arizona, and his office—located at 548 South Spring Street, Los Angeles—is doing a splendid work in helping irrigators who are interested in the uses of concrete in irrigation.

THE BUYERS' GUIDE TO LEADING SUPPLY SOURCES

Listing Practically All Standard Equipment Used in the Irrigation Country

THE IRRIGATION and hydraulic industry has, in the past, been greatly handicapped for the lack of some centralized Bureau of Information. Many jobbers, dealers and manufacturers representatives throughout the irrigation country have considered representation for commercial products of different types but did not know where to locate the names and addresses of the manufacturers of such appliances. The men who do ordering and specifying have not, in many cases, been able to consult an authentic directory of reliable equipment when writing for catalogs or quotations, compiling cost estimates or making out purchase orders. IN SHORT, THERE HAS BEEN NO STANDARD BUYERS GUIDE FOR THE INDUSTRY. It is in order that this need may be met, as adequately as possible, that MODERN IRRIGATION presents this current "Buyer's Guide to Leading Supply Sources," *corrected monthly.* It will, of course, become more complete as the publication grows in size. But since the present advertisers manufacture—or act as selling agents—for virtually all standard types of hydraulic equipment, this department should, at the outset, perform an invaluable service to buyers and sellers alike. The importance to the individual manufacturer of keeping his listings accurate and up-to-the-minute cannot be over-emphasized. Changes and corrections should be forwarded immediately. If any errors or omissions are noted in this month's listings, make sure that such incorrect listing will not appear again by sending your correction or revision by the next return mail. The listings "Main Branches or Agencies" are for branch offices or distributors in the irrigation country only and do not imply, necessarily, that the advertiser does not have branches elsewhere which are not included here.

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Byron Jackson Pump Mfg. Co.	Berkeley, California	1
Main branches or agencies: Byron Jackson Pump Mfg. Co., Sharon Bldg., San Francisco, Cal.; Byron Jackson Pump Mfg. Co., 412 S. San Pedro St., Los Angeles, Cal.		
California Corrugated Culvert Co.	411 Parker St., Berkeley, California	Outside Bk. Cvr.
Main branches or agencies: California Corrugated Culvert Company, 409 LeRoy St., Los Angeles, Cal.; California Corrugated Culvert Company, 745 Lake St., Reno, Nevada; California Corrugated Culvert Company, 1628 Floradora Ave., Fresno, Cal.; California Corrugated Culvert Company, 3422 Herbert St., San Diego, Cal.; California Corrugated Culvert Company, 1625 38th St., Sacramento, Cal.; Western Metal Mfg. Company, El Paso, Texas; Western Metal Mfg. Company, Houston, Texas.		
Charter Gas Engine Co.	441 East 3rd St., Los Angeles	49
Climax Engineering Co.	58 W. 18th St., Clinton, Iowa	6
Main branches or agencies: Climax Engineering Company, 1001 N. Orange Drive, Hollywood, Cal.; Coast Machinery Company, 464 E. Third St., Los Angeles, Cal.		
Concrete Machinery & Supply Co.	2014 Santa Fe Ave., Los Angeles, Cal.	51
Commercial Iron Works	2424 Porter St., Los Angeles, Cal.	Inside Bk. Cvr.
Main branches or agencies: Commercial Iron Works, 1228 H St., Fresno, Cal.		
Campbell, J. P. Irrigation Co.	Wilcox Building, Los Angeles, Cal.	47
DeLaval Steam Turbine Company	312 Union Oil Bldg., Los Angeles, Cal.	53
Main branches or agencies: DeLaval Steam Turbine Company, 531 Rialto Building, San Francisco, Cal.		
Fairbanks, Morse & Company	900 S. Wabash Ave., Chicago, Ill.	5
Main branches or agencies: Fairbanks, Morse & Co., Box 390 Arcade Sta., Los Angeles, Cal.; Fairbanks, Morse & Co., Spear and Harrison Sts., San Francisco, Cal.		
Great Western Meter Company	1290 Powell St., Oakland, Cal.	35
Hotel Plaza	Post St. at Stockton, San Francisco, Cal.	44
Kimball, Frank J. Company	Box 154, Arcade Sta., Los Angeles, Cal.	37
Main branches or agencies: F. M. Buckingham, 334 W. Moreland St., Phoenix, Ariz., Frank J. Kimball Co., 389 Santa Clara St., San Jose, Cal.; Frank J. Kimball Co., 2123 Inyo St., Fresno, Cal.		
Layne & Bowler Corp.	900 Santa Fe Ave., Los Angeles, Cal.	4
Los Angeles Mfg. Company	2500 E. 23rd St., Los Angeles, Cal.	40
Martin Iron Works	1222 E. 28th St., Box 757, Arcade Sta., Los Angeles, Cal.	2
Montague Pipe & Steel Co.	Hobart Building, San Francisco, Cal.	44
Main branches or agencies: Montague Pipe & Steel Co., 202 Market St., Oakland, Cal.		
Pacific Pump Works	350 Bickett St., Huntington Park, Los Angeles, Cal.	29
Pomona Mfg. Company	Pomona, Cal.	8
Price, G. W. Pump & Engine Company	1350 Folsom St., San Francisco, Cal.	49
Main branches or agencies: M. W. Lavender, Orosi, Calif.; Sanger Plumbing House, Sanger, Cal.; Byers & Lighty, Dinuba, Cal.		
Republic Flow Meters Co.	2240 Diversey Blvd., Chicago, Ill.	31
Main branches or agencies: Guy L. Warden, District Engineer, 589 Chamber of Commerce Bldg., Los Angeles, Cal.		
Roscoe Moss Company	4360 Worth St., Los Angeles, Cal.	35
Ruth Dredger Sales Corp.	Boyle & Slauson Aves., Los Angeles, Cal.	39
Snow Mfg. Company	2437 E. 24th St., Los Angeles, Cal.	51
Sparling, R. W.	945 N. Main St., Los Angeles, Cal.	
Sterling Pump Works	646 S. California St., Stockton, Cal.	27
Main branches or agencies: Sterling Pump Works, Inc., Delano, Cal.; Sterling Pump Works, Inc., 220 Broadway, Fresno, Cal.		
Vans Mfg. Company	519 N. Church St., Lodi, Cal.	43
Main branches or agencies: G. M. Doyle, Salinas, Cal.; R. D. Pelton & Son, Marysville, Cal.; Reedley Plumbing and Electric Co., Reedley, Cal.		
Western Pipe & Steel Co.	5717 Santa Fe Ave., Los Angeles, Cal.	3
Westinghouse Electric & Mfg. Co.	420 S. San Pedro St., Los Angeles, Cal.	Inside Frnt. Cvr.
Main branches or agencies: Westinghouse Electric & Mfg. Co., First National Bank Bldg., San Francisco, Cal.; Westinghouse Electric & Mfg. Co., J. & Mariposa Sts., Fresno, Cal.; Westinghouse Electric & Mfg. Co., 412 Luhrs Bldg., Phoenix, Ariz.; Westinghouse Electric & Mfg. Co., Mills Bldg., El Paso, Texas; Westinghouse Electric & Mfg. Co., 2415 El Capitan Ave., San Diego, Cal.		
Woolwine Metal Products Co.	2421 E. 8th St., Los Angeles, Cal.	

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AIR COMPRESSORS

Coast Machinery Corp. (See Climax Eng. Co.)
Fairbanks, Morse & Co.
Sterling Pump Works

AIR LIFTS

Coast Machinery Corp. (See Climax Eng. Co.)
Kimball, Frank J. Co.

BOILERS

Los Angeles Manufacturing Co.
Montague Pipe & Steel Co.

BUTTERFLY VALVES

Commercial Iron Works

CASING, WATER WELL

American Steel Pipe & Tank Co.
Los Angeles Manufacturing Co.
Montague Pipe & Steel Co.
Western Pipe & Steel Co.

CHECK VALVES

Commercial Iron Works
Vans Manufacturing Co.

CONCRETE MIXERS

Concrete Machinery & Supply Co.
Martin Iron Works

CONCRETE PIPE MACHINES

Concrete Machinery & Supply Co.
Martin Iron Works

CONCRETE PIPE MOULDS

Concrete Machinery & Supply Co.
Martin Iron Works

CONTRACTORS, WELL

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COUPLINGS, FLEXIBLE

De Laval Steam Turbine Company

CULVERT, CORRUGATED

American Steel Pipe Tank Co.
California Corrugated Culvert Co.

DREDGING MACHINES

Ruth Dredger Sales Corp.

DRILLING RIGS

Commercial Iron Works

DRILLING SUPPLIES

Commercial Iron Works
Roscoe Moss Company

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Westinghouse Electric Mfg. Co.

ELECTRIC MOTORS

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Westinghouse Electric & Mfg. Co.

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Fairbanks, Morse & Co.

ENGINE—GAS, OIL, GASOLINE, DISTILLATE

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Charter Gas Engine Co.
Coast Machinery Corp. (See Climax Eng. Co.)
Commercial Iron Works
Fairbanks, Morse & Co.

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Commercial Iron Works
Los Angeles Manufacturing Co.
Montague Pipe & Steel Co.
Vans Manufacturing Co.

FLAP VALVES

Commercial Iron Works

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Republic Flow Meters Company

FLOW METERS—STEAM, GAS & AIR

Republic Flow Meters Co.

FLOW METERS—WATER

Republic Flow Meters Company

FLUME, METAL

California Corrugated Culvert Co.

FORMS AND RINGS

Concrete Machinery & Supply Co.

FORMS, PIPE AND RINGS

Concrete Machinery & Supply Co.

GATES

American Steel Pipe & Tank Co.
California Corrugated Culvert Co.
Concrete Machinery & Supply Co.
Martin Iron Works
Pomona Manufacturing Co.

GATES—AUTOMATIC

California Corrugated Culvert Co.

GATES—CANAL

California Corrugated Culvert Co.
Concrete Machinery & Supply Co.

GATES—DRAINAGE

California Corrugated Culvert Co.

GATES—PRESSURE

California Corrugated Culvert Co.
Concrete Machinery & Supply Co.

GATES—RADIAL

California Corrugated Culvert Co.

GATE LIFTS

California Corrugated Culvert Co.

GATE VALVES

California Corrugated Culvert Co.
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GENERATORS — GAS-ELECTRIC

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Kimball, Frank J. Co.

IRRIGATION GATES

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California Corrugated Culvert Co.
Concrete Machinery & Supply Co.
Martin Iron Works
Pomona Manufacturing Co.

JACKS, HYDRAULIC

Commercial Iron Works

METERS

See "Water Meters, Recorders, Gauges, Indicators and "Meters, Electric."

METERS, ELECTRIC

Republic Flow Meters Co.
Westinghouse Electric & Mfg. Co.

MOTORS AND MOTOR CONTROL

Fairbanks, Morse & Co.
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MOTOR CONTROL

Westinghouse Electric & Mfg. Co.

OVERHEAD IRRIG'N EQUIP'T

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PENSTOCKS

Western Pipe & Steel Co.

PIPE, CORRUGATED

American Steel Pipe & Tank Co.
California Corrugated Culvert Co.

PIPE, GENERAL IRRIGATION

American Steel Pipe & Tank Co.
Los Angeles Manufacturing Co.
Montague Pipe & Steel Co.
Western Pipe & Steel Co.

PIPE, RIVETED STEEL

American Steel Tank & Pipe Co.
Los Angeles Manufacturing Co.
Montague Pipe & Steel Co.
Western Machinery Co.

PIPE, SURFACE IRRIGATION

American Steel Pipe & Tank Co.
Woolwine Metal Products Co.

PLASTER MIXERS

Martin Iron Works

PRESSURE SYSTEMS

Byron Jackson Pump Mfg. Co.
Fairbanks, Morse & Co.
Sterling Pump Works

PUMP HOUSES

California Corrugated Culvert Co.
Los Angeles Manufacturing Co.

PUMPS—BOOSTER

De Laval Steam Turbine Company
Byron Jackson Pump Mfg. Co.

PUMPS—CENTRIFUGAL

Byron Jackson Pump Mfg. Co.
Coast Machinery Corp. (See Climax Eng. Co.)
Commercial Iron Works
De Laval Steam Turbine Co.
Fairbanks, Morse & Co.
Kimball, Frank J. Co.
Price, G. W. Pump & Engine Co.
Sparling, R. W.
Sterling Pump Works
Vans Manufacturing Co.

PUMPS—DIAPHRAGM

Coast Machinery Corp. (See Climax Eng. Co.)

PUMPS—DRAINAGE

Byron Jackson Pump Mfg. Co.
De Laval Steam Turbine Co.
Price, G. W. Pump & Engine Co.

PUMPS—DREDGING

Price, G. W. Pump & Engine Co.

PUMPS—PLUNGER TYPE

Byron Jackson Pump Mfg. Co.
Coast Machinery Corp. (See Climax Eng. Co.)
Commercial Iron Works
Kimball, Frank J. Co.
Pomona Manufacturing Co.

PUMPS—POWER

Byron Jackson Pump Mfg. Co.
Fairbanks, Morse & Co.
Sparling, R. W.

PUMPS—PRESSURE

Byron Jackson Pump Mfg. Co.
De Laval Steam Turbine Co.
Fairbanks, Morse & Co.
Vans Manufacturing Co.

PUMPS—TURBINE TYPE

Byron Jackson Pump Mfg. Co.
Kimball, Frank J. Co.
Layne & Bowler Corporation
Pacific Pump Works
Pomona Manufacturing Co.
Sterling Pump Works

RECORDERS—WATER LEVEL

Republic Flow Meters Co.
Sparling, R. W.

RECORDING GAUGES, WATER

Sparling, R. W.

REPAIRS, ELECTRICAL

Westinghouse Electric & Mfg. Co.

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Califronia Corrugated Culvert Co.
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California Corrugated Culvert Co.

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Ruth Dredger Sales Corporation

VALVES

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Commercial Iron Works
Concrete Machinery & Supply Co.
Martin Iron Works
Pomona Manufacturing Co.
Sparling, R. W.
Vans Manufacturing Co.

VALVES—AIR

Concrete Machinery & Supply Co.

VALVES—ALFALFA

Concrete Machinery & Supply Co.

VALVES, AUTOMATIC CONTROL

Sparling, R. W.

VALVES—ORCHARD

Concrete Machinery & Supply Co.
Martin Iron Works

WATER LEVEL INDICATORS—

Republic Flow Meters Co.

WATER METERS, RECORDERS, GAUGES, INDICATORS

Commercial Iron Works
Great Western Meter Co.
Frank J. Kimball Co.
Republic Flow Meters Co.
Sparling, R. W.

WATER WHEELS

De Laval Steam Turbine Co.

WEIRS

California Corrugated Culvert Co.

WINDMILLS

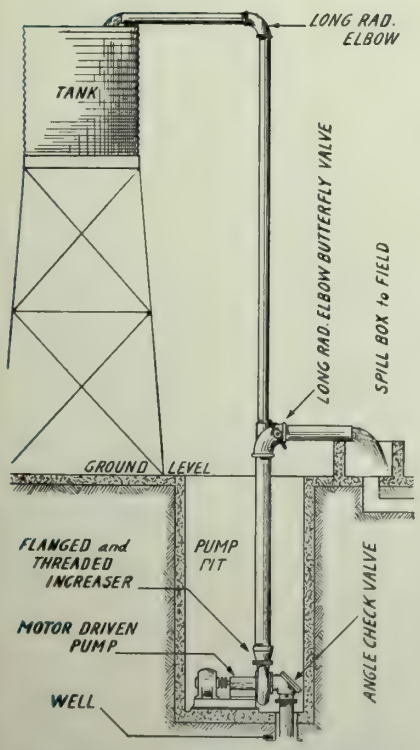
Fairbanks, Morse & Co.

WELL SCREEN

Layne & Bowler Corporation

WELL TOOLS

Commercial Iron Works
Roscoe Moss Company



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EDITORIALS

THE WORTH OF WATER; IS IT WORTH WHILE? WHAT'S ON YOUR MIND? 20-21

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For 12 Months: $2.00; Single Copies: 20 cents.

OWEN BROWN, President. W. C. MONROE, Vice-Pres. and Gen. Mgr. MINOR MOORE, Sec'y and Counsel

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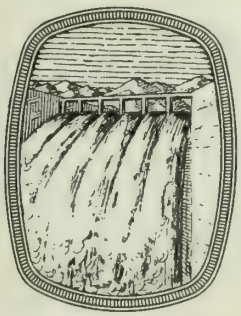
HUBERT WORK

Secretary of the Interior, who during July visited the national parks and reclamation projects of the northwest, in an endeavor to get face-to-face with his troublous tasks as head of this branch of the government. The sentiments voiced by Secretary Work on reclamation in general, and certain reclamation projects in particular, have made him the storm-center of an editorial deluge of praise and blame in the western states. Some of the comments which his policies have elicited are given on page 22.

MODERN Irrigation
The Magazine of Applied Hydraulics



Volume 1 AUGUST, 1925 Number 2

The Progress *of* Irrigation

MODERN IRRIGATION'S first issue, in the mails to several thousand readers of the irrigation industry the first of July, has set a new precedent in industrial journalism. Its reception has been more than gratifying to the publishers.

A magazine of this kind will not, in the ordinary course of things, sweep the country like a popular song, a best-selling novel, a slang phrase, or cross-word puzzles. Its advance, rather, must be of slow and ordered growth. Consequently, it is a matter for some surprise, as well as gratification, that MODERN IRRIGATION has found an immediate acceptance with so large a proportion of the irrigation field.

A veritable deluge of congratulatory letters and more tangible evidences of approval in the form of subscription checks have been crossing the editorial desk throughout the month. In an early issue there may be space to present a few of these expressions, from representative men of the industry, with a view to showing, not that MODERN IRRIGATION has made many staunch friends by its first appearance, (although that manifestly has been the case), but that these men welcome the institution of such an organ for the real need which it fills.

FOLLOWING hard upon the western tour of William M. Jardine, Secretary of Agriculture, Herbert Hoover, Secretary of Commerce, visited California during July, and Hubert Work, Secretary of the Interior, accompanied by Elwood Mead, Commissioner of Reclamation, was in the northwest during the latter part of June and the early part of July.

Secretary Hoover is a California man and his visits to "the Coast," where he is as much at home as at Washington, may not fairly be exaggerated into matters of political significance; but by the position which Mr. Hoover has attained in the affairs of the nation, it is impossible for him to go anywhere or say anything without that action or expression being carefully scrutinized. During his visit to Southern California, Mr. Hoover was asked for a statement on the always important matter of the Colorado River, and he made, according to the press, a definite declaration in favor of a "high dam" as the proper solution of the major problems involved—at the same time declaring that the interests of all parties

concerned dictate that the controversy around the Colorado River should be settled in some way, and at once, in order that the potentialities which it represents might be, at the earliest date possible, released for the common good.

SECRETARY Work's visit to the northwest has been a curious mixture, if one may judge from newspaper accounts, of cheers and denunciations. With Commissioner Mead he put in a very busy month visiting reclamation projects in Wyoming, Montana, Washington, Oregon and Idaho; and as reclamation is not the only concern of his department, he was obliged to crowd much other business into his trip, such as tours of inspection to the national parks of the northwest.

According to the present reclamation policy of the administration, as evidenced by the statements of the Interior Department, Secretary Work is compelled to discriminate very carefully between the numerous projects which are competing for federal assistance. His tour was largely an attempt to get first-hand information which would allow him to make this discrimination intelligently and judiciously. Consequently, it is natural that those sections which meet with his approval as feasible projects, deserving of encouragement, should look upon his policies with very different feelings than those which impress him less favorably.

Regardless of whether all the policies of the department are wise, Secretary Work's position is obviously an uncomfortable one, and it is not altogether surprising that he has been met with hozannas on the one hand and roundly scored for his actions on the other. An article in another part of this issue records some of the diverse editorial comments that have greeted the secretarial party on its tour.

OPINIONS of the temperamental fitness of Secretary Work to be the head of the Reclamation department of the government are widely contradictory. A personal difference between the Governor of California and the Commissioner of Reclamation has added to the controversial troubles of this Bureau. But it can hardly be denied, by partizans on either side, that the Secretary is doing the wise thing in going to see the reclamation projects at close range.

Rumors of Secretary Work's possible resignation of his present portfolio continue to follow him in spite of his arduous efforts to get better acquainted with this aspect of his job. Secretary Weeks, of the War Department, is a sick man, and Work is mentioned as a possible successor in the event of his resignation. All such reports, however, are officially denied in the Interior Department, and the Secretary himself denies it by continuing his attempts to get a bird's-eye view of reclamation.

THE key contentions of both the Secretary and the Commissioner are that reclamation is more than a matter of getting water on the land; that it is a matter of getting profitable crops and able farmers to use the water, after it is obtained; that the states should co-operate with the federal government in assisting feasible projects; and that settlers who are able to pay the government should not be allowed to evade their obligations.

Pure logic, however, in a situation where so many personal equations are involved, may not be safely pushed to the limit, and no successful solution of the reclamation problem may be obtained without making a nice balance between these rationalistic considerations and the personal needs of settlers already on the land. Abstract feasibility does not seem to them as real or important as the concrete problems which are all about them, and in which they feel entitled to assistance from the same government which encouraged them to undertake their responsibilities.

THAT the people of the west as a whole are convinced of the value of an expanding irrigation program is evidenced, meanwhile, by continued reports of growth. Irrigation, by new bond-issues voted, new projects planned and surveyed, and new irrigation structures completed and dedicated, displays the symptoms of a vigorous financial and physical condition in spite of its isolated failures.

In this single issue there are recorded: a plan for the reclamation of government desert lands by pump irrigation, to be introduced before the next Congress; the completion of the Tieton Dam, in Washington; the approval of a bond issue to complete the Medina Irrigation Project in Texas; the definite declaration of Elwood Mead, Commissioner of Reclamation, that the Kittitas (Wash.) project will go through by one means or another; and greater or lesser developments of the same kind in California, Oregon, Idaho and many other parts of the irrigation country.

Enthusiasts for irrigation, looking over the western horizon, may catch many encouraging signs. The pioneering period of the industry has passed, and while, from many standpoints, the present is a crucial period in its history, it may be confidently anticipated that the lessons of the past will not have been in vain, and that the collective wisdom of irrigationists will be able to work out a sure salvation.

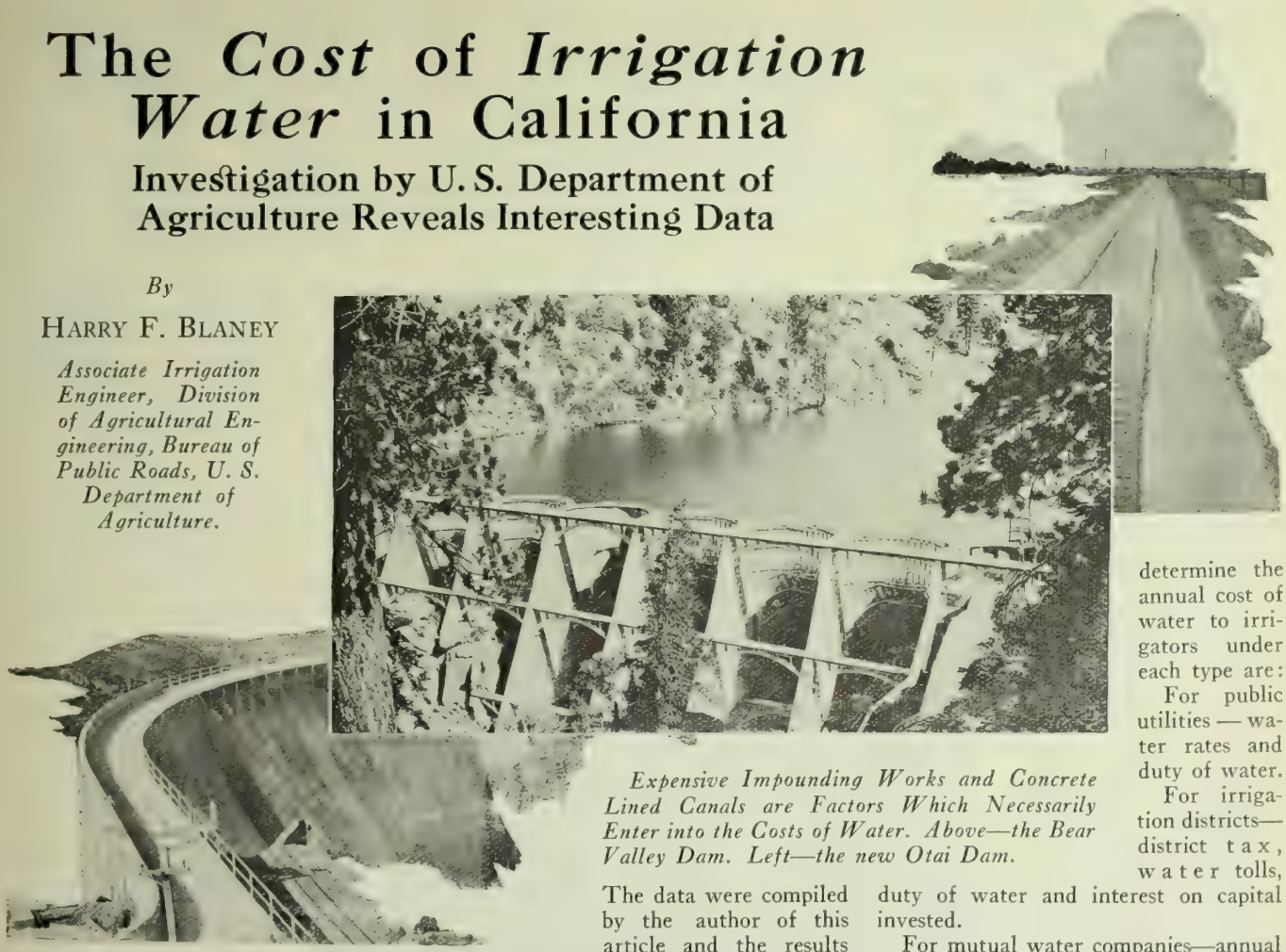
The *Cost* of *Irrigation Water* in California

Investigation by U. S. Department of Agriculture Reveals Interesting Data

By

HARRY F. BLANEY

Associate Irrigation Engineer, Division of Agricultural Engineering, Bureau of Public Roads, U. S. Department of Agriculture.



Expensive Impounding Works and Concrete Lined Canals are Factors Which Necessarily Enter into the Costs of Water. Above—the Bear Valley Dam. Left—the new Otai Dam.

IRRIGATION water yearly is becoming of higher value and more difficult to obtain; in consideration of which fact bankers, investors, government officials, engineers and farmers may well ask what expenditure can be justified to develop a water supply on land suitable for growing high-grade crops, and what water charge can such land pay. Farmers and prospective farmers are in need of such cost data as will enable them to choose crops that may be grown profitably under existing water charges.

The costs of irrigation water to the farmer in the pioneer days were generally a minor factor in his total annual expenditures. Today, however, the annual cost of irrigation water may, in many cases, be the determining factor as to whether or not the enterprise is feasible for any but high-priced crops.

The Division of Agricultural Engineering of the United States Department of Agriculture, the Department of Public Works of California, and the California Agricultural Experiment Station have co-operated in a field study of the cost of irrigation water in California. The data were compiled by the author of this article and the results published as a state bulletin under the title, "Cost of Water to Irrigators in California." As only a limited number of copies were printed, this article, substantially a digest of the report, has been prepared as of interest to many irrigators who have not had access to the bulletin.

IN CALIFORNIA many types of enterprises may furnish irrigation water. However, most of them may be placed under one of four classifications: public utilities, irrigation districts, mutual water companies, or private pumping plants. Data on a total of nearly 200 public utility water companies, irrigation districts and mutual water companies, and 72 private pumping plants were obtained throughout California. In addition to annual cost of water, information on the type of irrigation system, locality, age, source of water, acreage irrigated, kind of crops, capital invested, and water charges were compiled and summarized in tables.

Cost data for these types of enterprises are not always comparable, as their forms of organization and the items entering into the cost of irrigation water are different. The principal factors that determine the annual cost of water to irrigators under each type are:

For public utilities — water rates and duty of water.

For irrigation districts—district tax, water tolls, duty of water and interest on capital invested.

For mutual water companies—annual assessments, water rate, duty of water and interest on capital stock.

For private pumping plants—cost of power, attendance and all fixed charges.

COMPARISONS between two systems of the same type of enterprise are often difficult to make because factors affecting the cost of water have a wide range of variation. For example some projects deliver water to every 10 acres, others to every 160 acres, leaving the farmers to take care of the remaining distribution system. In some systems where gravity water is depended upon without storage, the irrigator supplements this supply by a private pumping plant to tide over a dry season and thus adds to his regular irrigation charges.

One project may have expensive storage reservoirs, diversion works, pumping plants, or a concrete pipe or lined canal distribution system while another will depend entirely on unstored gravity water with unlined ditches. The irrigator should weigh such facts carefully before coming to the conclusion that he is paying too much for water in comparison with other projects.

Some idea of the variation of the annual cost of irrigation water may be

obtained from the following tables which summarize the costs under each type of enterprise for different sections of the state.

TABLE 1—SUMMARY OF ANNUAL COST OF WATER UNDER PUBLIC UTILITIES

	Cost of water including interest on capital invested			
	Per acre		Per acre-foot	
Section of Calif.	Min.	Max.	Min.	Max.
Northern	$1.51	$12.00	$ .92	$ 6.01
Central	.56	5.64	.30	4.24
Southern	5.54	32.67	1.85	25.14
Entire State	.56	32.67	.30	25.14

Practically all the water used under the public utilities in Northern California is gravity, with some storage. In Central California, where the cheapest water is found, it is all gravity with very little storage. In Southern California the high rates are due either to expensive storage works for gravity water, cost of pumping water, or costly distribution systems on account of the scarcity of water.

TABLE 2—SUMMARY OF ANNUAL COST OF WATER UNDER IRRIGATION DISTRICTS

	Cost of water including interest on retired bonds			
	Per acre		Per acre-foot	
Section of Calif.	Min.	Max.	Min.	Max.
Northern	$3.28	$12.00	$ .37	$18.00
Central	.90	24.69	.53	16.35
Southern	4.04	21.00	2.66	22.19
Entire State	.90	24.69	.37	22.19

The lowest annual cost of $0.90 per acre is for a system which depends on gravity water without storage. Most of the crops that need water after July 15 are irrigated by private pumping plants and the cost of this irrigation is not shown. On the other hand, the highest cost of $24.69 is under a district where all the water is pumped through an average lift of about 300 feet, the distribution system consisting of steel, redwood and concrete pipe and the average cost of litigation, for the past two years, being about $5.00 per acre. These two illustrations will give some idea of the reasons for the wide variations in costs per acre among the different districts.

TABLE 3—SUMMARY OF ANNUAL COST OF WATER UNDER MUTUAL WATER COMPANIES

	Annual cost of water including interest on capital invested			
	Per acre		Per acre-foot	
Section of Calif.	Min.	Max.	Min.	Max.
Northern	$1.84	$13.67	$ .55	$ 7.82
Central	.83	36.17	.40	27.44
Southern	2.07	60.07	1.22	50.91
Entire State	.83	60.07	.40	50.91

The cheapest water is supplied by the older gravity systems, some of which were constructed in the early fifties. Some are capitalized at a few dollars per acre, which does not represent the true present value of the water. In the absence of proper basis for interest charges the main expense under them consists of fees paid to the zanjeros. In a few instances, the farmers do most of the work themselves.

The lowest cost per acre is for a system using 1.68 acre-feet of water per acre. This cost per acre is made up of interest, $0.17, and an average annual assessment of $0.83, from which is deducted $0.17 for sinking fund, leaving a total cost per acre of $0.83. The lowest cost of $0.40 per acre-foot is for a company having the following items of cost per acre of water: interest of $0.41 and average assessment of $0.71, from which is deducted $0.20 for sinking fund, leaving a total per-acre cost of $0.92. This, divided by the duty of water of 2.30 acre-feet per acre for the system, gives a cost of $0.40 per acre-foot.

For the entire state, the highest costs are found under systems which pump all their water, although there are some gravity systems in Southern California that have higher costs than many pumping systems.

TABLE 4—SUMMARY OF ANNUAL COST OF WATER FOR PRIVATE ELECTRIC PUMPING PLANTS

	Annual cost of water including fixed charges					
Location	Per acre-foot		Per acre		Per acre-foot Per foot lift	
	Min.	Max.	Min.	Max.	Min.	Max.
Sacramento Valley	$2.81	$55.31	$3.01	$45.63	$ .065	$1.317
Santa Clara Valley	4.04	56.34	5.34	33.08	.125	.378
San Joaquin Valley	1.56	18.42	6.96	48.08	.040	.301

The figures given for the private pumping plants in the Santa Clara and San Joaquin Valleys are for 1923, while all other data are for the year 1922. In the Sacramento Valley the lifts ranged from 30 feet to 73 feet; in the Santa Clara Valley from 29 feet to 208 feet; while in the San Joaquin Valley the lowest lift was 10.5 feet and the highest 249.9 feet.

IT IS difficult to make very accurate comparisons of the cost of irrigation water according to crops grown, because most systems furnish water to more than one kind of crop, and very few keep records that would make this possible. However, tables 5, 6, and 7, appearing on this page, give some indications of the variations in costs for citrus trees, deciduous trees and vines, and alfalfa under different types of enterprises in California.

The increasing cost of water calls for the greater economy in its use by the irrigator. Many irrigation systems have reduced their overhead expenses to a minimum. However, in some localities there is little inducement for the irrigator to use water economically, as no measurements are made, and the water is paid for at a flat rate regardless of the amount used.

Many farmers do not utilize their pumping plants fully. Either the

(*Continued on Page 28*)

TABLE 5—SUMMARY OF ANNUAL COST OF WATER FOR CITRUS TREES

	Min.	Max.	Min.	Max.
Public Utilities	$ 5.00	$32.67	$1.47	$25.14
Irrigation Districts	.90	24.69	.60	16.35
Mutual Water Companies	1.84	60.07	.55	50.91
Private Pumping Plants[1]	16.22	48.08	4.21	18.42

[1]Figures given for private pumping plants in Table 5 are not comparable with other enterprises as they represent only a few plants in San Joaquin Valley and are for 1923.

TABLE 6—SUMMARY OF ANNUAL COST OF WATER FOR DECIDUOUS TREES AND VINES

	Annual cost of Irrigation Water			
Type of Enterprise	Per acre		Per acre-foot	
	Min.	Max.	Min.	Max.
Public Utilities	$ .56	$25.14	$ .30	$25.14
Irrigation Districts	.90	24.69	.53	22.19
Mutual Water Companies	.83	41.28	.40	27.67
Private Pumping Plants[2]	5.34	33.08	4.04	56.34

[2]Figures shown for private pumping plants in Table 6 are for Santa Clara Valley in 1923 and are not comparable with other enterprises.

TABLE 7—SUMMARY OF ANNUAL COST OF WATER FOR ALFALFA

	Annual cost of Irrigation Water			
Type of Enterprise	Per acre		Per acre-foot	
	Min.	Max.	Min.	Max.
Public Utilities	$ .56	$25.14	$ .30	$25.14
Irrigation Districts	.90	21.00	.53	8.90
Mutual Water Companies	.83	41.28	.40	16.82
Private Pumping Plants[3]	9.53	45.63	2.91	19.09

Type of Enterprise	Annual cost of Irrigation Water Per acre	Per acre-foot

[3]Figures for private pumping plants in Table 7 are for seventeen tested pumping plants in the Sacramento Valley and are not comparable with other enterprises.

How the Tractor May Serve the Irrigator as a Valuable Source of *Dual-Purpose* Power

On Many Smaller Ranches it is Proving Itself a Satisfactory Power Plant for Varied Uses

By ARNOLD P. YERKES

IT IS very true that "good equipment makes a good farmer better," but even the best equipment cannot earn money when it is idle. The more steadily equipment of any kind can be kept at profitable work, the greater the amount of money it will earn.

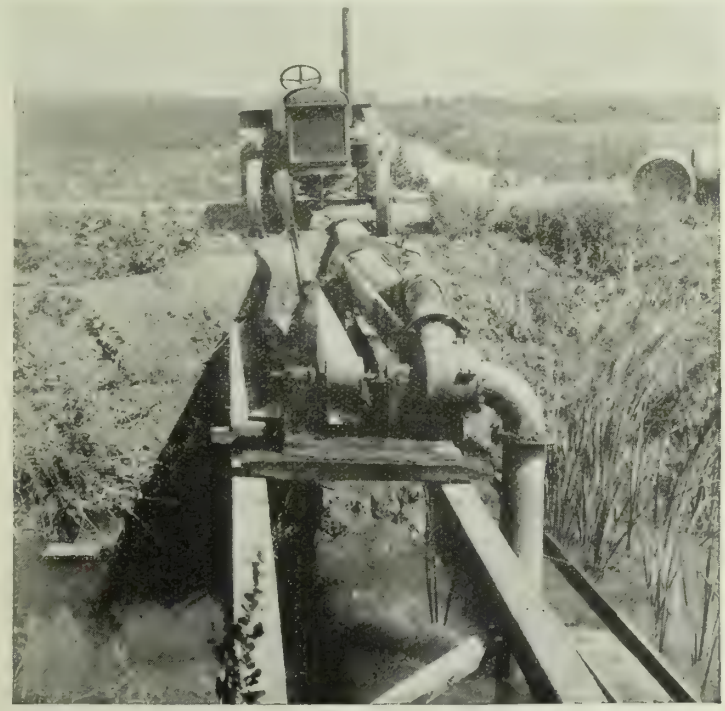
In the industrial world, the competent manufacturer realizes this fact and strives to keep his equipment, especially the machines which represent a considerable investment, busy at profitable work as great a share of the time as can possibly be done. Machines which were bought for one particular purpose are frequently used for other jobs in order to keep them earning instead of standing idle when there is no work for them at their regular tasks.

What is good practice for a manufacturer is, generally speaking, good practice for a farmer, for there are many things in common between a well managed factory and a well managed farm.

ALL of which leads up to the point it is desired to make—that the tractor lends itself particularly well to a large amount of profitable work each year on an irrigated farm where it can be used not only for a great many kinds of field work, such as plowing, cultivating, leveling, ditching, road grading, ditch-cleaning, chiseling, etc., but for pumping water as well.

Of course, on the larger irrigated ranches the ordinary farm tractor can scarcely be considered a practical power plant for pumping, except as an auxiliary. On many smaller ranches, however, the heavy investment required for the large pumping plants, which are commonly found on the big ranches, is beyond the means of the owner or tenant, and here the farm tractor, in the larger sizes, has proved a very satisfactory and economical dual-purpose power plant.

One of the most valuable features of the tractor in such cases is its comparatively low cost. Usually a special engine for pumping purposes, with a power capacity equal to that of the larger farm tractors, will cost considerably more than the latter and will, of course, pump no more water in a given period. Inasmuch as it will be necessary for the operator to have power of some kind for his field work as well as for his pumping, if he can make one set of equipment do both jobs, he has at the outset saved the expenditure of a considerable sum of money.



THE TRACTOR LENDS ITSELF TO A WIDE VARIETY OF TASKS ON THE IRRIGATED FARM. THIS ONE IS DRIVING A 6-INCH PUMP, DISCHARGING INTO AN 8-INCH PIPE.

Then, since utilizing the single power plant at several jobs will lengthen its working season each year, its earning capacity is likewise greatly increased; so he is making two worth-while savings by this practice, to say nothing of the additional advantages of having only one machine to learn to operate and to require repairs.

EVEN in the not uncommon case where a tractor which is capable of doing all the field work on a ranch is not capable of pumping enough water for the acreage under cultivation and it is necessary to buy a second tractor, the total investment is still not as great as though one large power plant and a tractor had been purchased, and the the second tractor will be of real value for emergency field work if the other breaks down, or at times when it is desirable to rush the work of cultivation faster than one tractor is capable of doing it.

Since pumping water for irrigation is hard and continuous work, it is always advisable to exercise considerable judgment in buying and installing the pumping plant, so as to insure getting one which the tractor can operate satisfactorily. The average farmer usually does not have the necessary information at hand from which to calculate the proper size of pump, pulleys, etc. The safest procedure in such cases will usually be to write the agricultural engineer at the state college or to the engineering department of the company which built the tractor, giving all the necessary information such as the height of the lift, length of the horizontal pipe, the model and rating of the tractor, etc.

It is usually advisable to obtain a pumping outfit which will normally require a trifle under the engine's capacity, inasmuch as it is difficult to keep an internal combustion engine operating at 100 per cent efficiency at all times. Worn rings, leaky valves, and other causes of lost power which may develop during continuous operation will then not interfere so quickly with the satisfactory operation of the pump. It is true, too, as every automobile owner knows, that operating troubles are much less frequent

(*Continued on Page 31*)

Will Government *Desert Lands* be Made Fruitful by a System of Pump Irrigation?

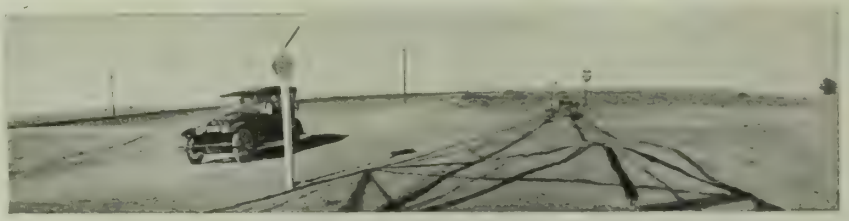
Land Office Official Outlines Plan for Reclaiming Arid Acres, to Begin With the Mojave Desert

By BRAINERD B. SMITH

Register, U. S. Land Office at Los Angeles

MUCH has been written, both in fiction and in fact, about the Great American Desert, which seems to hold, for most people, a mysterious charm.

We have seen the mountains and hills, that rise out of these deserts, bring forth their treasures of gold, silver, and other precious metals; we have seen the flat "dry lake" areas produce salt, potash, borax and many other useful minerals; and we have seen the homesteader and other land settlers come, put in a few weary years, and go—whipped for the lack of water. The abandoned and dilapidated shacks that dot the desert give mute evidence of the land settlers' losing conflict with nature.



ABOVE—A TYPICAL MOJAVE DESERT VISTA; THE ONLY SHADE IS THAT CAST BY THE STEEL TOWER OF A HIGH VOLTAGE ELECTRIC POWER LINE. BELOW—THE DESERT RECLAIMED. AN ALMOND ORCHARD ON IRRIGATED "DESERT" LAND (NORMAN F. MARSH RANCH NEAR HESPERIA).

The history of the western migration of the American people is most interesting. The desire in the hearts of a great many people to own a "piece of land" has, in the last century, exhausted the government lands in fertile valleys and practically all other lands upon which water could be easily placed. The U. S. Reclamation Service has reclaimed thousands of acres of arid lands by diverting rivers and streams for irrigation, and the land seeker has settled these lands.

We are now, therefore, becoming concerned with those desert areas situated where there are no rivers or streams from which water can be diverted for irrigation, and where the average rainfall is not sufficient to mature crops. It is these vast areas that make up the bulk of the remaining vacant government land, and it is upon these lands that future generations must settle.

WHERE, and how, are we going to get the water to irrigate these desert areas, where the average annual precipitation is less than six inches? We have spoken of the failures on account of the lack of water, and we are endeavoring, at the present, to work out a practicable plan whereby some portion of these deserts can be brought under successful cultivation. Our desire is to make it possible for the homesteader to remain on his land after he has settled there.

But the only water that is available to irrigate these deserts lies beneath them, and these ground waters must be pumped to the surface if the lands are ever to be cultivated.

The average homesteader cannot finance himself sufficiently to drill wells that will supply water for adequate irrigation; very large tracts of land cannot be purchased from the government, so that private interests may develop them; and the greater portion of these desert lands are the property of the United States. It seems reasonable, then, to the writer, at least, that if the wells are ever to be drilled the government will be required to drill them for the benefit of the homesteader.

UNITED States Senator Samuel M. Shortridge and the writer have gone over considerable data in considering the feasibility of systematically drilling wells in the desert areas. Many of these areas are far removed from ready markets, and so situated that it would be difficult for a land settler to dispose of his crops. Such areas cannot, therefore, be considered for development at this time. In the seven far western states there are approximately 135,000,000 acres of vacant government land. Statistics are not available for determining what exact portion of this vast area is desert in character, but an inspection of the maps would indicate that more than half of the entire area, or about 70,000,000 acres, can be classified as desert lands. We are designating as "desert lands" those broad, level or gently sloping arid lands found in the western United States.

A small proportion of this 70,000,000 acres, located near rivers and streams, will be reclaimed by diverting water to the land, but the larger proportion is left, and demands consideration.

THE problem of bringing under cultivation these desert areas that are to be irrigated by pumping water from wells must be considered in a practical manner. By a process of elimination, having in view those areas best suited for the first project of pump irrigation, the Mojave Desert has been selected as the most feasible.

(*Continued on Page 41*)

LOUIS C. HILL

CARL E. GRUNSKY

ARTHUR P. DAVIS

Engineering Ably Represented on Modern Irrigation's *Board of Advisors*

SEVEN members of the Board of Advisors of MODERN IRRIGATION were introduced in the first number, by reproduction of their portraits and short summaries of their careers as they have had to do with irrigation. These comprised the agricultural and conservation groups of the Board.

In this issue seven more members are presented — those who constitute the group which, out of a total present membership of some thirty individuals, will probably exert the most definite influence in shaping the editorial contents of the magazine. They are the engineers, and they represent and typify the most eminent skill and the most successful experience of the profession.

These men have agreed to give MODERN IRRIGATION the benefit of their broad-range perspective of the technical advance of irrigation, and, by their counsel, to guide it in such paths that the magazine may serve the engineers and technicians of the industry to maximum advantage. Assurance that the advisory work of this department will be done by experts may be gained from a perusal of the following outline of their experience in the fields of reclamation and irrigation.

The place held by Arthur P. Davis in engineering is best told by a matter-of-fact recital of the tasks to which he has devoted the past forty years. From 1882 to 1894 he was connected with the Geological Survey, first as topographer and later in government irrigation surveys and stream measurements. From 1897 to 1901 he was engaged in making surveys in charge of all hydrologic work for proposed interoceanic canals in Nicaragua and Panama. From 1902 to 1923 he was identified with the Reclamation Service, first as assistant chief engineer, then as chief engineer and finally, from 1914 to 1923, as Director of the service.

During this time his skill was frequently called into service by important projects outside of the Reclamation Service. He was a member of the Board of Consulting Engineers on the Panama Canal and consulting engineer on hydraulic works in Porto Rico; he investigated irrigation projects in Turkestan at the request of the Russian Government; was named on a committee to study Panama Canal slides by the National Academy of Sciences; went to China for the Red Cross to study flood conditions; and was consulting engineer on high dams in many parts of the United States, in Mexico and Alaska.

In 1923 Dr. Davis was named Technical Advisor of a Commission for the adjustment of pecuniary claims between the United States and Great Britain. In 1922 and 1924 he was a lecturer on Hydraulics at Yale University, and is now chief engineer and general manager of the East Bay Municipal Utility District, of Oakland, California, where he lives. Among the degrees and honors conferred upon him are the degrees of Bachelor and Doctor of Sciences, from George Washington University, and Doctor of Engineering, from Iowa College. In 1920 he was president of the American Society of Civil Engineers, and is now a member of its Board of Direction.

CARL E. GRUNSKY is also a past president of the American Society of Civil Engineers, having held that position in 1924. He began his professional career with the state engineering department of California in 1878, and was connected with the state service for ten years, successively as topographer, assistant, and chief assistant. In 1888 and 1889 he was engaged in private practice at Sacramento and later at San Francisco, dealing largely with irrigation and sewerage problems. During the following several years he was a member of the California Examining Commission of Rivers and Harbors, (1889-90); consulting engineer to the Commission of Public Works, (1893-95) a member of the San Francisco Sewerage Commission, (1892-93); City Engineer of San Francisco, (1900-04); a member of the Isthmian Canal Commission appointed by President Roosevelt, (1904-05); consulting engineer in the U. S. Reclama-

A. L. SONDEREGGER

tion Service and advisor to the Secretary of the Interior, (1905-07).

For a short time Dr. Grunsky was in private practice in New York, and later in San Francisco, where he is now senior member of the C. E. Grunsky Company, engineers.

Dr. Grunsky is a native Californian, born in San Joaquin County. His higher education was obtained in Europe. He holds the degree of Dr. Ing., from the Polytechnicum Stuttgart, Germany, of which he is an alumnus, and that of Eng. Dr. from Renssaeler, granted in 1924. Other honors which have been conferred upon him include the presidency of the California Academy of Sciences and the Pacific Division of the American Association for the Advancement of Science.

LOUIS C. HILL, a member of the firm of Quinton, Code & Hill, Consulting Engineers of Los Angeles, has been actively engaged on many varied and important projects pertaining to irrigation and hydraulic developments.

His training was received at the University of Michigan, from which he was graduated in 1886, with the degree of Bachelor of Science in Civil Engineering and later the degree of Bachelor of Science in Electrical Engineering. The honorary degree of Master of Engineering was conferred on him in 1911. He is a member of the American Society of Civil Engineers and of Tau Beta Pi.

Until 1903 he was professor of hydraulics and electrical engineering at the Colorado School of Mines, when he resigned to accept a position as engineer in the newly organized Reclamation Service of the United States. He was soon made Project Engineer of the Salt River Project where his work included complete supervision of construction of the Roosevelt Dam and allied works. Two years later, he was appointed Supervising Engineer over all the United States Reclamation Service Projects in the entire Southwest, his duties requiring close supervision of the construction of the Laguna Dam on the Colorado River, of the Elephant Butte Dam on the Rio Grande, and of the tunnel and dam of the Strawberry Project in Utah, as well as various other reclamation projects.

In 1914 he left the Reclamation Service to enter private practice, although retained by the Government as Consulting Engineer to the present time. Among the larger works upon which he has

EDWARD HYATT, JR.

been engaged since entering private practice are the irrigation development of the Goodyear Tire & Rubber Company's lands in the Salt River Valley, Arizona, the Gibraltar Dam for the City of Santa Barbara, the proposed Madera Dam on the San Joaquin River, and the 990,000 acre irrigation project on the Yaqui River in Sonora, Mexico. He has been connected with various municipal water supply problems, having served the City of Los Angeles as one of a board of three appointed for consideration of the City's water supply requirements, and also the proposed dam for Stockton, California.

A. L. Sonderegger is one of Southern California's best known engineers, and is known particularly as an authority on ground-water problems in the irrigation country. As a consulting engineer, he has specialized in hydraulic engineering, having been established for the past twenty years in Los Angeles. His experience has included varied contacts with all aspects of both municipal and irrigation water problems.

Mr. Sonderegger has acted as consulting engineer for a number of cities in Southern California, and for several years was consulting engineer for the receiver of the California Development Company (predecessor to the present Imperial Irrigation District). He has also been prominent in ground-water litigation and has made extensive studies of groundwater supply, flood control and conservation. He served as a member of the Board of Engineers appointed by the City of Los Angeles in 1924 to report on the available water supply for the city. Mr. Sonderegger has to his credit a large number of technical papers on ground water and flood control.

He is a graduate of the Swiss Institute of Technology at Zurich, a member of the American Society of Civil Engineers and a certified member of the American Association of Engineers.

W. F. McCLURE'S official position as Director of Public Works and State Engineer of California would be sufficient to establish his right to a place in a representative group of this kind, entirely apart from his own wide experience and signal success in the profession, but of course he would never have attained the former without the latter. His relation to engineering in general and to irrigation is told briefly in the following comment from a recent issue of the Sacramento *Union*:

(*Continued on Page 28*)

R. V. MEIKLE

Baxter passed the hot-dog stand, and the merry-go-round, and finally came to the "Machinery Building," behind the "Crazy-House." The white tent at the left is the object of his search.

Under the Tattered Canvas

The Story of John Baxter's Search for the Machinery Building at the State Fair

By C. A. UTLEY

"I SUPPOSE that's probably the Machinery Building," John Baxter told his wife, as they entered the State Fair Grounds at Sacramento. He pointed to a large, brick building about two blocks down the main entrance street. "I'm more interested in what's in that building than all of the other exhibits put together, but what do you say we look into a few of these tents and smaller buildings, on the way over?"

The Baxters—typical "dirt-farmers" of the younger generation—had moved from Iowa to California, a few months before the opening of the State Fair and were visiting the fair for the one purpose of looking over the display of farm machinery. John Baxter had graduated from the College of Agriculture, at Ames, Iowa, and Mrs. Baxter was not far behind him in up-to-date knowledge of the feminine side of agriculture. The attractive advertising appeals of the Californians, Inc., Southern California All-Year Club, and the Los Angeles Chamber of Commerce had finally pried them loose from their native soil and here they were in California.

Mr. Baxter was a very methodical man. Before purchasing the eighty acres which he now owned, he had enlisted the services of the best soil experts from the College of Agriculture, at Davis, had satisfied himself that a plentiful supply of pumping water, at a proper distance from the surface, was available; in short he was entering into a business which, if properly planned, was sure to be a success.

AFTER the electric power company had installed their transformers near his partially completed house, his troubles began. He was literally besieged with pump and machinery salesmen by the score. Each one gave him advice just a little different from the others. Hence his decision to spend a day at the State Fair, looking over the various types of pumps, motors, etc., where he could see each one demonstrated in the State Fair testing laboratory.

They turned into a tent at their left and were surprised to find that it contained nearly a hundred thousand dollars worth of automobiles. "Strange," commented Mr. Baxter, "that such valuable stuff should not be housed in a building instead of a tent. Well, I suppose the best buildings are used to exhibit pumping equipment and farm machinery, since this state boasts that it leads the world in the use of irrigation and other kinds of machinery."

"Forget about that wonderful pump exhibit for awhile," Mrs. Baxter replied, "and let's go into this building. I can see an electric refrigerator just inside the door. Maybe they will be exhibiting pumps in here."

John Baxter gave his wife a superior smile and mumbled something about her having no idea of the magnitude of a machinery building suitable for a state like California. "You've been through machinery buildings at other state fairs often enough to know that an up-to-date state like California wouldn't exhibit farm machinery in a woodshed," he said.

Mr. Baxter remembered hearing a lecturer from the Division of Agricultural Engineering, at Davis, who had proudly stated that ninety per cent of the farm work in California was done by machinery, a large percentage of which was electrically operated.

After looking over the exhibits in the "Manufacturers Building," the greater part of which was housed in a tent, annexed to the rear end of the building, they emerged from the side entrance of the tent and were headed once more toward the big brick building.

"Oh! let's go in here," Mrs. Baxter said, "I think it's the School Exhibit which I've been told is worth seeing. We've plenty of time to see everything as we come to it, then you can spend all afternoon in your machinery building, while I look at the poultry and other things that I'm interested in."

MR. BAXTER allowed himself to be veered from his straight course to the brick building, after looking hesitatingly at his watch. "All right," he said, "I guess a half a day ought to be enough to see most of the machinery exhibits."

In walking through the School Exhibits Building, Mr. Baxter noticed a lot of pipes in the unfinished top of the building and, upon inquiry, was told that this building formerly housed the irrigation equipment. A look of incredulity passed quickly over Mr. Baxter's face, but he thought, "Oh well, a small building like this would soon be outgrown; no doubt the machinery manufacturers were

glad to get out of this little box."

Mrs. Baxter forgot about the poultry building and accompanied Mr. Baxter across the green lawn, on the way to the entrance to the main building.

"Just get this artistic view," Mr. Baxter exclaimed, as they were walking across the lawn. "On the left is a small, but artistic building, directly in front is Machinery Hall, and if there were only a nice building of some kind on the right, to shut out the view of those sheds, it would be a scene for an artist to paint. It's certainly appropriate that a great state like California should recognize the foundation of its prosperity and give first place at the State Fair to irrigation equipment and farm machinery, for it's not hard to visualize just what California would look like were it not for irrigation. Remember the old cistern pump we had in Iowa? Now it's automatic pressure systems, overhead sprinklers, underground concrete pipe—"

"John dear, that's all interesting enough but let's go in and *see* these things instead of standing here in the sun," Mrs. Baxter said.

AS they entered the big building they saw at once that it did *not* contain machinery. Apples, prunes, pumpkins—in fact every thing that could be grown out of the soil—was piled high in artistic profusion. The many interesting exhibits in the building made Mr. Baxter forget all about his interest in irrigation equipment for a time. Attendants at all of the booths assured the Baxters that proper irrigation was responsible for all of the wonders before their eyes.

Finally after looking through the beautiful California Fish and Game Exhibit, exhibits from nearly every county in the state, electric range demonstrations, et cetera, Mr. Baxter was now firmly decided that he would find the irrigation equipment exhibit.

As they left the main entrance, Mr. Baxter inquired of a stranger where the machinery building was located. The stranger was not sure but he thought that it was one of those little buildings about a block south of the big building. Mrs. Baxter balked, at this point, and arranged to meet her housband later in the Fine Arts Building, where, she had been told, were plenty of comfortable chairs.

Mr. Baxter was getting somewhat weary but he was determined now, more than ever, that he would find the Machinery Building.

On arriving at the small buildings, which had been pointed out by the stranger, he found them to be horse stables and was directed by a jockey to the extreme north end of the grounds, where, the jockey said, he had seen some pumps in a box car on the spur track. This did not sound very encouraging, particularly since Mr. Baxter thought he detected a faint smile on the face of his informant when mention was made of the "Machinery Building." However, he mopped the perspiration from his face and started in the direction which the jockey had pointed out.

After what seemed to be an endless walk, Mr. Baxter arrived at the north end of the grounds, where he found several small sheds which were used to house hogs and sheep. Repeating the same inquiry to one of the attendants in

A CORNER OF THE "PUMP-TENT"

the hog-sheds, he was directed to the Secretary's office, which, he was told, was located in the big, brick building. Mr. Baxter was hardly in a mood to thank his second informant, and muttering something under his breath, he retraced his steps in quest of the Secretary's office, which was easily found.

As he paused inside of the door, he was met by the genial Superintendent of Exhibits, who, after listening to Mr. Baxter's rather peevish recital of his unsuccessful efforts to find the irrigation equipment exhibit, took him by the arm, led him out of the back door, past a "hot-dog" stand and pointing down a dusty street, said, "See that hot-dog stand at the corner of that shed? Well, you go down there, turn to your left to an orangeade stand, then turn to your right, past the merry-go-round and 'crazy-house' and you'll find the pump-tent."

"Pump-tent," mechanically repeated Mr. Baxter.

"Oh well, they call it the pump tent," the Superintendent of Exhibits explained, "but that's where all of the irrigation equipment is exhibited and everybody calls it the 'pump-tent' for short."

MR. BAXTER headed for the "hot-dog" stand, as directed, made his way through the procession of horses and cattle that were led out for display, past the "crazy-house," and at last found the "pump-tent." He stopped for a moment to get his bearings; looked back at the dome of the big, brick building, which was discernible over the top of the merry-go-round, and turned to enter the "pump-tent." In doing so, he caught his foot in one of the tent ropes and plunged headlong into the mud, which was covered with a thin sprinkling of rice hulls to give it an appearance of respectability.

Thus far Mr. Baxter had not lost his temper, but as he picked himself out of the mud, some of the nearby pump exhibitors who were lounging in front of their empty exhibits, heard some choice "cuss" words. Scraping the mud from his elbows, Mr. Baxter hurriedly took in the situation at a glance, turned to leave the tent, then remembering what he had come to see, decided to see the irrigation equipment exhibit as quickly as possible.

Stopping in front of the first exhibit on the right, he saw a pump which was delivering about a third of a stream of water. Upon inquiry, he was told by the attendant in charge of that exhibit, that the wind, that morning, had blown off a piece of the rotten tent and that that portion of what should be a partial covering for the irrigation equipment, was now in his pump, hence the diminutive stream of water, accompanied by the grinding sounds from the pump.

As he walked around the tent, Mr. Baxter was unfavorably impressed by the sameness of the whole exhibit, inasmuch as every pump was operating as if in a treadmill, lifting the water about two feet and discharging it back into the pit—to be lifted again the same two feet and discharged back into the pit, ad infinitum. "So this is the Machinery Building," growled Mr. Baxter to himself as he left, brushing the dried mud off his knees. He glanced into the tractor tent as he was leaving but didn't go in. He had seen enough.

He presented a forlorn appearance as he walked into the lounging room of the Fine Arts Building, where his wife was waiting for him.

"Why John," Mrs. Baxter gasped, as she saw his disheveled appearance, "have you met with an accident?"

"I've been through the machinery building," Mr. Baxter replied, with an expression on his face which told Mrs. Baxter the whole story. "Let's go home!"

THIS HILLSIDE HAS BEEN DENUDED—THE RESULTS TO IRRIGATION ARE NOT DIFFICULT TO IMAGINE.

PHOTO BY U. S. FOREST SERVICE

What *Conservation* Means to *You*—and to *Irrigation*

By FRANCIS CUTTLE

President, Water Conservation Association

WHETHER he be *interested*, or not, every individual is affected by the question of the conservation of our natural resources. Even a cursory examination of this question will convince the most casual observer that all industry, commerce and trade are, in the last analysis, dependent upon the natural resources of the country. Indeed, it is claimed, on highly competent authority, that the conservation of our forests and our water resources is absolutely necessary to the prosperity of the country. It may not be too much to say that without our forests, poverty and distress would soon follow; for history shows that depopulation follows deforestation as night follows day.

The forests of the United States originally were so vast in extent and variety, and so abundant, that they were accepted as something that might be used and abused without let or hindrance and without thought of dire consequences. In fact, the idea seems to have become fixed in the minds of the people at large that these forests are inexhaustible; that no more care need be taken of them, to secure their perpetuation, than is taken to perpetuate the light and heat of the sun or the air that we breathe.

IN THE PATH OF THE DESTROYER

— PHOTO BY U. S. FOREST SERVICE

The stripping of vast areas for the upbuilding of towns and cities as population increased was hailed as evidence of progress and development. The destruction of large areas by fire was only decried and dreaded as these fires menaced the homes and lives of any particular section, which then, of course, became alarmed; but with the passing of the fire, or if these fires were at some distance, the resultant property destruction was dismissed as of no interest or consequence.

UNFORTUNATELY the idea that our forests are "inexhaustible" is still firmly fixed in the minds of many people and may be ascribed as the reason for the terrible apathy and inertia of the public when called upon to take any action to prevent their destruction or steps to insure their perpetuation.

The original virgin forested area of this country has dwindled from 822,000,000 acres to about 135,000,000 acres and we are now cutting and destroying our remaining supply from four to six times as fast as it is being produced. The remaining virgin supply cannot last more than 15 to 20 years at the present rate of production and consumption, and it takes from 125 to 175 years to grow a tree to saw-timber size (under very favorable conditions of soil and moisture trees have been grown to about one foot in diameter in 65 years, but this is far above the average).

WHAT, then is to become of this country in the interim from the time of the depletion of our timber supply until a new supply can be grown? Read the answer in the history of the countries which already have lost their population, notably Northern Syria, and you will find that the claim that depopulation follows deforestation has been complete.

While we are a strong and rich nation, we cannot violate nature's laws without suffering the consequences. If all the wealth and man-power of this great nation were brought to bear upon just one sapling it could not be forced to grow to a full-sized tree in less time than nature's laws require.

Notwithstanding the rapidly diminishing supply of timber, we are still wasting two-thirds of the tree from where it stands in the forest to the ultimate con-

(*Continued on Page 30*)

The EDITORIAL

MODERN Irrigation

An Organized Voice for the Forces of Agriculture and Industry Which are Primarily Dependent upon Irrigation.

Published Once a Month
AT LOS ANGELES, CALIFORNIA, BY THE
PETROLEUM WORLD PUBLISHING CO. *Editorial and Executive Offices, 626 South Spring Street, Telephone Broadway 3262.* Branches: SAN FRANCISCO—447 SUTTER STREET, *Telephone Garfield 2772;* H. E. TAYLOR, *Manager.* CHICAGO—1163 MONADNOCK BLDG., *Telephone Wabash 8855;* JOSEPH E. O'CONNOR, *Manager.* NEW YORK—503 FIFTH AVENUE, ROOM 308, *Telephone Vanderbilt 8753;* WERNER HAUPTLI, *Manager.*

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Executive Editor

By Annual Subscription in the United States and possessions, $2.00; Foreign, $2.50; Single copies on sale in the irrigation country, 20 cents. In ordering change of address, give both the old and the new address. Allow ten days for re-entries on the subscription list. Advertising rates and circulation data upon request. Checks should be made payable to Petroleum World Publishing Co.

VOL. I AUGUST, 1925 No. 2

Introducing Our Board

IN THE July issue of MODERN IRRIGATION, the first to come from the press, considerable space was devoted to the purposes and the organization behind the magazine. It was promised that in subsequent issues our concern in ourselves would be less evident. That promise, we believe, is carried out in the present number.

One article in this issue, however, merits especial consideration: the one which introduces the seven members of the Engineering Group on our Board of Editorial Advisors. This article, we feel, calls for no word of apology. We are proud, and rightfully so, of the calibre of the men who have consented to serve as counsellors to MODERN IRRIGATION. A reading of their records, as presented on pages 15 and 16, will explain just why.

In coming issues of the magazine the remaining groups of the board will be dealt with in similar fashion until all of them have been introduced. We feel certain that our readers will find this series of personal sketches of very genuine interest, not only because the subjects are connected with MODERN IRRIGATION, but because interest always attaches to the work and personalities of men who have done, and are doing, constructive things.

The Worth of Water

HOW much is water worth? This is a question that permits no more of a categorical answer than the famous query about the age of Ann, and yet it is one which demands an answer from every irrigator who is contemplating or carrying on the production of a given crop under conditions where irrigation water enters as a major item of cost. Today, the annual cost of water is, in many cases, the determining factor that decides whether or not the farming enterprise is feasible for the production of any but the most high-priced crops.

An article in this issue presents the results of a painstaking investigation into the costs of water to the irrigator in California, under varying sorts of enterprises. Every irrigation executive knows his own costs, the factors which enter into them, and where they should be lower, if there is a possibility of reduction. But not all have the opportunity to compare their own circumstances with those of other enterprises.

The figures of the Department of Agriculture, given in the article on the cost of water to California irrigators, may be a revelation to some readers as to where their properties stand with relation to the average of similar enterprises in representative parts of the irrigation country. To some, these figures will give reason for self-congratulation. To others, perhaps, they will serve as an inspiration to new economies.

Is It Worth While?

FOREST-FIRE season is upon us. As we go to press the newspapers tell of destructive blazes in many parts of the country. The head-lines tell of these great fires while they are at their height, chronicle the number of acres burned over and the casualties involved; but as the conflagration subsides, public interest in the subject is extinguished before the fire itself.

It is well that the people should be told about the lives lost in these fires, and the damage done to property, because it brings home to them, to some extent, the need for corrective measures. But it would be still better if they could be told, day after day, in every season of the year, that their own livelihood (to a large extent) and certainly that of their posterity, depends upon building up what the fire demon has mowed down, and in staying his ravages by forest protection.

In this issue of MODERN IRRIGATION, Francis Cuttle, one of the best known conservationists of the west, tells something of what conservation means to the irrigator and to the nation at large. It may, perhaps, be said that of all audiences in the world, an irrigation audience is the one least in need of such appeals as this. But irrigation is, also, most concerned in this problem, and until every one of us is alive to the pressing need of action, we can hardly expect relief from those whose interest is less direct and visible.

POINT *Of* VIEW

Possibly it is true that irrigators realize the importance of conservation more than other classes of people; but, if so, it then becomes their duty to spread that gospel abroad.

In the future we expect to deal repeatedly with this great subject, for it is one of paramount importance, and the more thoroughly saturated with its facts the irrigationist becomes, the more chance he has of making his influence felt in the direction of wise measures for conservation, reforestation and afforestation.

What's on Your Mind?

IT TAKES time for any new institution to establish itself in the minds of the people with whom it must deal. It will be months, at least, before MODERN IRRIGATION comes to stand for a definite, clearly defined concept in the minds of the workers in irrigation.

There is a popular jest about the hypothetical Englishman who, in his daily routine, encountered some trifling circumstance not to his liking in the usually well-ordered affairs of London life, and, as the immediate and logical measure of correction, sat down and wrote a ten-page letter about it to the London Times. But behind such a jest there must be a germ of truth and sincerity, which speaks very well indeed for the newspaper that, to the troubled Britisher, is looked upon as both friend and confidant.

It is something of this very kind that MODERN IRRIGATION aspires to become, frankly, in relation to the man engaged in any branch of the irrigation industry and its allied fields. Its purpose is to deal with, and to afford an open forum for the discussion of, the real and tangible problems that confront men who do things with water. In order that it may realize this ideal, it must have candid expressions from these men themselves. Is there something on your mind that we might helpfully discuss—or throw open to discussion by others in the industry? If so, give us the benefit of your ideas or your suggestions.

A Useful Department

TWO departments of the national government are officially concerned in irrigation, and are, through their activities, instrumental to a large degree in promoting advances in irrigation practice. The one which comes first, probably, to the mind of the reader, is the Department of the Interior. Its participation in irrigation is direct and practical, through its Bureau of Reclamation, and by virtue of the work of this Bureau, the Government of the United States is probably the largest single irrigator in the world. This department is active in irrigation also through its Indian Irrigation Service.

There is another department, however, which has direct contact with irrigation in a rather different way. That is the Department of Agriculture. Many of those who are constantly in contact with this branch of the government do not clearly understand the organization through which the department exercises its functions in the irrigation field. The form of organization is, indeed, rather involved and its nomenclature obscure.

The following outline will help to explain the relationship of irrigation activities to the Department as a whole:

1. Department of Agriculture.
   a. Bureau of Public Roads.
      1. Division of Agricultural Engineering.
         a. Drainage Investigation.
         b. Irrigation Investigations.
         c. Rural Engineering Investigations.

The irrigation investigations of the government are thus carried on as one subdivision of the activities of the Division of Agricultural Engineering, which is, in turn, a division of the Bureau of Public Roads, of the Department of Agriculture.

S. H. McCrory is Chief of the Division. Samuel Fortier, until his retirement from active service early in 1925, was Associate Chief, but he is now connected with the Division, in accordance with the rules for retirement, merely in a consulting capacity. W. W. McLaughlin succeeded Dr. Fortier in charge of the western office of the Division, at Berkeley, and holds the office of Acting Associate Chief.

These men are performing a real service for irrigated agriculture. While the activities of the Division are divided into investigations of drainage, irrigation, and rural engineering, the Berkeley office, which is the headquarters for the work in all the western states, is primarily concerned with irrigation. Much of the most valuable work of the Division is done through co-operation with local organizations—the state engineering departments, state universities and agricultural colleges, and state experiment stations.

A Tribute to Irrigation

COMMENTING on the recent meeting, in Salt Lake City, of the American Society of Civil Engineers, the Salt Lake *Deseret News* pays the following tribute to irrigators and irrigation:

"The outstanding subject of this gathering was irrigation, and it was pointed out that irrigation has released mankind from the bonds that once held him to the humid belt. It has made possible his reaching out and developing areas which were formerly thought to be not fit for man. Irrigation has benefitted not only those acres lying under the ditch, but the tracts above the ditch as well, for were there not developed farms, homes and communities, on the irrigated areas, there would be no industries and helpful pursuits along the uplands. It is a noteworthy fact that the products of irrigation constitute new wealth, which is widely distributed. Without irrigation it would have been impossible to settle and develop this great arid and semi-arid West."

Reclamation Chiefs, Touring in Northwest, Are Accorded Diverse Editorial Welcome

Secretary Work and Commissioner Mead, on Busy Trip, Arouse Varied Reactions of Gratitude and Resentment

ONE newspaper hails Hubert Work, Secretary of the Interior, on the occasion of his official visit to the northwest, as one who "speaks with understanding, on the unanimous advice of an able fact-finding commission," and asserts that the purpose which he outlines "will have the earnest support of an overwhelming majority of the people of the west."

Another editor calls the Secretary "the arrogant Dr. Work," and describes his visit as "spreading a pall of disappointment over Eastern Oregon," by his "negative attitude toward reclamation;" while from Boise, Idaho, comes the report that the Secretary's orders that water shall be turned off land of settlers in arrears in their obligations to the government have made him the storm center of a most contentious dispute.

THESE diverse reactions indicate at least one tangible result from the tour of the reclamation party through the northwestern states—a revived interest in irrigation and reclamation matters on the part of the press. The progress of the Secretary and Elwood Mead, Commissioner of Reclamation, with other members of the government party, through Wyoming, Montana, Washington, Oregon, and Idaho, has been marked by a continuous broadside of editorial comment, favorable and unfavorable, depending largely upon the attitude which the officials have taken toward local reclamation enterprises.

The northwestern trip of the Interior Department chiefs has been an intensely busy one. During the concluding days of June they visited projects in Wyoming and Montana, including the Milk River, Casper-Alcova, Sun River and other projects. At several points en route Secretary Work was called upon for speeches, and voiced in no uncertain terms his official attitude toward the problems of reclamation.

On June 26 the Secretary, after a visit to the Sun River project, spoke to a group of farmers at Great Falls, Montana, and declared that the successful future of western reclamation demands that "we should first *reclaim reclamation,* restore confidence in its government representatives, establish enthusiasm and discredit those who live by farming the farmers."

These thoughts have been the outstanding message of his speeches throughout the trip. At a banquet in honor of the official visitors, held at Spokane on June 30, both the Secretary and Dr. Mead gave expression to their attitude toward reclamation in addresses which received wide attention in northwestern newspapers.

"Reclamation has failed utterly, up to now," declared Secretary Work, while at the same time he affirmed his faith in its future possibilities. "We propose to begin to build up reclamation from the farm end rather than the dam end. The future of reclamation is brighter than ever in its history because we have taken time to discover the causes of its failure."

At Yakima, Washington, on July 2, Secretary Work spent an active day, officiating at dedicatory ceremonies for the huge Tieton dam, and turning the lever that released water for the irrigation of 10,000 acres of Washington land, and in the evening delivering an address in which he scored dishonesty on the part of settlers on reclamation projects in avoiding their obligations to the government.

AT SEATTLE, the visitors were in conference with Governor Hartley of Washington on the future development of the Kittitas project, which has been prominently in controversy between various factions in the state. Commissioner Mead made the positive statement that, regardless of the outcome of the interview with the governor, the government would go ahead with the $9,000,000 Kittitas development. In case Governor Hartley remains inflexible in his unwillingness to grant state aid to the project, several other ways are open by which the obstacles now in the way of completing the work may be removed, was the substance of his assertion.

From Seattle the party went to Portland, conferred with Governor Pierce of Oregon, visited the Vale, Baker, Owyhee, and Greely projects, and had conferences with the representatives of still other reclamation districts.

It was the "negative attitude" of the Work party toward some of these developments, notably the Baker and Vale projects, that "spread a pall of disappointment over eastern Oregon," according to the Portland *Journal,* whose correspondent notes the departure of the visitors for "a more contentious scene in Idaho," and hints: "That the apparently arbitrary and 'hard-boiled' attitude might reflect a negative policy on the part of the administration toward the expansion of western progress has been suggested."

SECRETARY Work's forthright statement that "reclamation has failed;" his desire to induce the governors of the states to pledge their efforts to obtain state aid for the projects as evidence of a desire to co-operate in the new reclamation policy; and his denunciation of settlers who, able to support fine cars and splendid homes, are still delinquent in their debts to the government, have naturally elicited various editorial comments. In sections where the reclamation officials have pledged their faith and support to contemplated projects, as in the Columbia Basin area, these comments are much more cordial than in those places where the "negative attitude" has been in evidence, such as the Baker and Vale projects, in eastern Oregon.

The Lewistown, (Montana) *Democrat-News* believes that "it is unlikely that the plan of Secretary Work to solicit financial aid from the states will be met with favor in Montana, not because our people would not most willingly grant such assistance, but because the state is financially unable to do so at this time."

Another Montana editor, however—of the Kalispell *Interlake*—believes that the new policy outlined by the Secretary marks a "long step forward" as it "recognizes the faults in the present system."

Commenting on the determination of Secretary Work and Commissioner Mead to enforce payment of debts from those able to pay, the Spokane *Spokesman-Review* is entirely in accord with their policy. It scores the evasion of debts in an editorial headed "West Will Not Stand for Repudiation," and says: "Secretary of the Interior Work and Commissioner Mead have started out resolutely to convince them of the error of their view. In this just and proper course they will have the support of an overwhelming majority of the people of the west."

(*Continued on Page 35*)

THE IRRIGATION DIGEST

A Monthly Bulletin Board of Brief Facts and Events from Far and Near

GRANTS PASS, OREGON.—One hundred interested business men of Grants Pass and farmers of the vicinity joined recently in a tour of the Grants Pass irrigation district to view the achievements which irrigation has made possible in this section.

MARYSVILLE, CALIF.—The Excelsior Water & Power Company is planning a million-dollar power and irrigation project on Deer Creek, on the South Fork of the Yuba River, it has been announced by Ray Manwell, secretary of the recently organized Yuba Water Users Protective Association.

MARYSVILLE, CALIF.—Proceedings have been initiated looking to the formation of the Dry Creek Irrigation District, embracing 9,435 acres of land in the Dry Creek section, between Marysville and Wheatland. The plan of the proposed district is to impound the waters of Dry Creek and tributaries.

THE DALLES, ORE.—Land owners in northern Wasco County have initiated proceedings for the formation of an irrigation district for the purpose of placing water on lands extending from the Dufur neighborhood to Mt. Hood Flat and Mill Creek. The irrigation of thirty thousand acres is contemplated.

BEND, OREGON — A survey of the Deschutes Irrigation Project under the direction of the Reclamation Bureau has been assured by the success of the Deschutes Project Association in raising $5,000 to match an available federal appropriation of the same amount for the purpose.

DALLAS, TEXAS—Engineers in charge of construction of the new water reservoir for the city of Dallas, being constructed at Garza, on the Elm Fork of the Trinity River, have announced that the $5,000,000 project will be completed on schedule time. The seventy-billion gallon body of water to be formed will be known as Lake Dallas.

SALT LAKE CITY, UTAH—The Utah Water Storage Commission has determined by official action that the Echo Canyon Reservoir and the Kamas flat canal will comprise the first units of the Great Salt Lake Basin Project. The Echo Reservoir will cost $3,000,000 to build. Water rights will be sold on a basis of 74,000 acre-feet at $40.55 per acre-foot.

SANTA FE, N. M.—A storage reservoir to cost $350,000 is to be built on the Bluewater Project, Valencia County, New Mexico. The dam will be ninety feet high and will impound water to form a lake seven miles long, and to put 10,000 acres of land under irrigation. Ten miles of main canal and from 15 to 20 miles of laterals will be constructed on the project.

MANILA, P. I.—Eighteen million pesos will be the amount of the expenditure of the government in the Philippine Islands for irrigation when projects now under construction have been completed. The current projects will be completed sometime in 1926. The irrigation systems developed by the expenditure of this amount of money have added about 100,000 hectares to the arable lands of the islands.

LOS ANGELES, CALIF. — A plan to expend $50,000 on an irrigation system for Griffith Park, a natural park in the outskirts of Los Angeles, has been approved by the water department of the city. The plan embraces the planting of green fire-breaks in place of the present bare fire-breaks in the park, and the irrigation of these by means of wells sunk in the dry bed of the Los Angeles River.

SAN DIEGO, CALIF.—The California State railroad commission has issued an order authorizing the sale of the Cuyamaca water property to the La Mesa, Lemon Grove and Spring Valley irrigation district. Under the terms of the sale the irrigation district pays $1,000,000 in bonds, the district voting some time ago an issue of $2,500,000 with which to take over the Cuyamaca system and to make improvements.

SAN FRANCISCO, CALIF.—Up to July 20 a total of 708 fires have been reported in the National Forests of the California district for the year, corresponding with 830 fires at the same date in 1924. The decrease is largely due to a reduction in the number of man-caused fires, of which in 1924 there were 556, and only 176 reported to date in 1925. District Forester Paul G. Redington, commenting on this record, pointed out the need for continued watchfulness during the remaining months of the summer, saying: "The worst of the season is still before us."

SANTA ROSA, CALIF.— Plans for a large irrigation project in Napa, Lake and Solano Counties, involving the irrigation of 60,000 acres of land from Putah Creek, have been revealed in an application filed with the state division of water rights.

The application seeks a permit to appropriate 400 cubic feet per second and 300,000 acre feet a year from Putah Creek, to be diverted in section 26, township 8 north, range 2 west and stored in section 26, township 8 north, range 2 west, and section 13, township 11 north, range 6 west. C. A. Tusch, 2211 Union Street, Berkeley, is the applicant.

COLTON, CALIF.—Under the supervision of City Engineer Charles A. Hutchinson of Colton, the Lytle Creek Conservation Association is commencng work, preliminary to the construction of a long, low retarding dam to provide a more efficient system of water distribution by maintaining a greater head. Flood control enters into the plan incidentally, but the main endeavor will be to create a greater head of water permanently to the end that the expense of pumping will be greatly reduced. Engineer Hutchison was selected as Supervising Engineer for the initial work, by the committee representing the constituted authority on the water interests concerned.

Engineers' Conclave Is Devoted Largely to Irrigation

American Society, in Summer Meeting, Discusses Problems of Water and Water Power

Meeting at Salt Lake City, Utah, on July 8, 9, and 10, the American Society of Civil Engineers devoted their attention to irrigation, reclamation and hydro-electric power as the dominant themes of their annual Summer Meeting.

The most eminent engineers of the nation were gathered at the conference, and many of the west's outstanding authorities had prominent places on the program.

Among the well-known men of the western irrigation industry who presented papers and participated in the discussions at the opening session were: Samuel Fortier, senior irrigation engineer of the Division of Agricultural Engineering, Department of Agriculture; Arthur P. Davis, a past president of the Society, now Chief Engineer and General Manager of the East Bay Municipal Utility District, Oakland; C. E. Grunsky, also a past-president, senior member of C. E. Grunsky Co., San Francisco; F. A. Banks, U. S. Reclamation Service, American Falls, Idaho; R. E. Shepherd, president of the Western States Reclamation Association, Jerome, Idaho; John E. Field, consulting engineer, Denver; and Louis C. Hill, consulting engineer, Los Angeles.

At later general and divisional sessions of the meeting, devoted to various phases of irrigation development, the following were speakers:

William Kelly, Director of Engineering, National Electric Light Association; Barry Dibble, consulting engineer, Redlands, Calif.; Markham Cheever, General Superintendent and General Manager, Utah Power & Light Company, Salt Lake City; Frederick H. Tibbitts, consulting engineer, San Francisco; M. C. Hinderlider, State Engineer, Denver, Colorado; Elwood Mead, Commissioner of Reclamation.

B. A. Etcheverry, Professor of Irrigation Engineering, University of California; Thomas H. Means, consulting engineer, San Francisco; Warren G. Swendsen, State Engineer, Boise, Idaho; Charles H. West, Assistant Professor of Rural Institutions, University of California; E. Court Eaton, Irrigation Engineer, Sacramento; Frank Adams, professor of Irrigation Investigations and Practice, University of California; Richard R. Lyman, Civil and Consulting Engineer, Salt Lake City; and J. B. Lippincott, consulting hydraulic engineer, Los Angeles.

S. T. Harding, Associate Professor of Irrigation, University of California; Elmer A. Porter, Chief Engineer, Sevier River Land & Water Company, Salt Lake City; O. W. Israelson, Professor of Irrigation and Drainage, Logan, Utah; Charles H. Lee, consulting engineer, San Francisco; Fred C. Scobey, U. S. Department of Agriculture, Berkeley, Calif.; G. E. P. Smith, Professor of Irrigation Engineering, University of Arizona; J. C. Stevens, consulting hydraulic engineer, Portland, Oregon; Marvin Chase, consulting engineer, Olympia, Washington; Fred H. Henshaw, district engineer, U. S. Geological Survey, Portland, Oregon.

Montana Irrigation Body Plans Constructive Work

Committee on Education and Colonization Opens Way for Consideration of Important Problems.

The recent appointment, by C. E. Atwood, President of the Montana Irrigation and Drainage Institute, of a Committee on Education and Colonization, is enterpreted by some observers to signalize the beginning of a new era of usefulness of that body in the field of land settlement, with which it has not hitherto actively concerned itself.

The chairman of the Committee, as announced by President Atwood, is L. A. Campbell, Director of Labor and Publicity of the Montana State Department of Agriculture, who is in charge of the department's colonization program. Associated with him are: Dean F. B. Linfield of Spokane, Washington; W. M. Wayman of Shelby, and R. W. Speir of Valier.

Dean Linfield is director of the experiment station of the State college at Bozeman; Mr. Benson is Agricultural Agent of the Northern Pacific Railway; Mr. Wayman is a pioneer in the development of irrigation in Montana, and Mr. Speir is Engineer on the Valier Irrigation Project in Pondera County.

The first task of the committee will be to formulate a statement of the problems and limitations of Montana settlers and the officials upon whom they rely and to work out a plan to make their work more effective and to lend encouragement to officials and to the settlers.

Approve Drainage Program

The Board of Governors of the Salt River Valley Water Users' Association has approved a program to drain the various water-logged spots on the Salt River project not taken care of under the present drainage system.

Equipment Men in Session at San Francisco

Association Discusses Varied Problems of Industry; Next Meeting September Eleventh at Sacramento

Financing the installation of pumping outfits, the standardization of electrical equipment, the second-hand, or used pump problem, standard contract and specifications suggestions and a host of other items, all of major importance to the irrigation equipment industry, were discussed and acted upon at the July 10 meeting of the Western Irrigation Equipment Association, held in San Francisco.

An executive session during the morning, devoted to routine problems of the association, was attended by C. F. Zimansky, Joseph H. Cox, C. A. Utley, Joseph L. Lawrence, J. J. Merritt, J. E. Lundy, V. E. Nittinger, and P. L. Nourse.

At the afternoon business session the principal speaker was Newton C. Owen, of the Contract Department of the Anglo-California Bank, who explained the credit system evolved by his organization for the assistance of manufacturers and dealers of farm equipment in selling their products on terms comparable to those used in selling automobiles, pianos and other so-called luxuries. The bank is carrying paper at eight per cent on the installation of pumping plants for individual irrigators. Under this plan, the purchase is allowed to make a down-payment of one-third, and to distribute the balance over twelve monthly payments, or, in the case of farmers who depend on an annual crop, to hold an unpaid balance over until the crop comes in. The latter arrangement, of course, involves a slightly higher carrying charge.

The subject of second-hand pumps is always good for a rousing discussion, and its introduction at the July meeting proved no exception. E. M. Breed, of San Francisco, is chairman of a committee appointed to deal with this troublesome problem, and this body is working on a plan by which some central agency may be created to take over the responsibility of distributing used equipment returned from a given territory because of the lowering of the water table to a point below the level of the pump's operation. Such an agency could place equipment of this kind in territory where water conditions would allow successful operation.

The standardization of power plant regulations for the installation of electrical equipment is another matter demanding immediate attention. V. E. Nittinger of San Francisco, assisted by a committee of his own choosing, is arranging

(*Continued on Page 28*)

Holds Water Not Taxable as "Improvements"

New Mexico Attorney General's office Renders Opinion in Response to Official Query

An opinion handed down by James N. Bujac, Assistant Attorney General of New Mexico, in response to an inquiry from the State Tax Commission, declares that irrigation water placed on the land may not be taxed as "improvements."

"However," declares the opinion, "the placing of water on the land would, of course, increase the value of the land and, it naturally follows, that the value of the equity of a purchaser of said land would accordingly be increased and this equity could be assessed and taxed at its increased valuation."

The legal point was raised when the county commissioners of Eddy County attempted to increase the assessed valuation of property within the county in order to provide a full-term school session. The letter addressed to the Attorney-General's office by the Tax Commission follows:

"I am inclosing letter from the tax assessor of Eddy county in connection with the assessment of lands which have been procured by purchase from the state. These lands are being assessed upon equity based as provided by the 1921 laws.

"It would seem that a great many of these lands are irrigated and are producing crops equal to the lands owned in fee simple and which are assessed at about $60.00 per acre. The state purchase lands, of course, bear only a very small percentage of the tax burden of the county.

"The county commissioners and assessor are attempting to raise the valuation of that county for the purpose of providing a full term of school and in this connection they desire to find some plan whereby the state purchase lands can be assessed for more than the equity of the purchaser and therefore, they have concluded to assess the water as improvements.

"You are requested to advise the tax commission whether or not it is legal for the county assessor and board of county commissioners to assess the water placed on this land as improvement."

Water Levels Recover

According to a report from the California Division of Water Rights, ground water planes in the Kings River district are showing a marked recovery, insuring an ample supply for pumping during the remainder of the season.

Plan Big Bear Survey

The California Division of Water Rights has announced that a comprehensive field investigation of water conditions in the region of Big Bear Lake, San Bernardino County, will be undertaken immediately. The Division says that the Big Bear region has reached the point where it is the most highly developed summer domestic area in the state. Harold Conkling, hydraulic engineer, will be in charge of the investigation of the water situation.

Tieton Dam Unbound to Water 100,000 Acres of Land

Second Largest Earth-fill Dam in World Formerly Known as Rimrock, Opened with Ceremonies

With appropriate ceremonies conducted before a crowd of enthusiastic citizens from many parts of Washington, the great Tieton Dam, formerly known as the Rimrock Dam, was completed and dedicated during July.

Hubert Work, Secretary of the Interior, was chosen to pull the lever that released the waters through the valves of the dam. Mrs. Nellie Strawn Benedict, oldest living white person born in Yakima County, Washington, where the dam is located, was the sponsor of the structure.

The following are some interesting facts concerning the dam as told by newspaper correspondents:

Located on the Tieton River, 42 miles from Yakima, it is the second highest earth-fill dam in the world. It will impound 202,000 acre-feet of water, which, with normal run-off, will serve 100,000 acres of land. The lake formed by the dam will be nine miles long, with the average width of one mile.

The first survey for the dam was made in 1916, a road constructed and camp established in 1917. The war made necessary the cessation of building activities until 1921, when actual construction of the dam was commenced. It was completed in April, 1925.

Its height from bedrock to crest is 321 feet; from river bed to crest, 233 feet. Length across top, 905 feet. From the upstream to the downstream toe, its thickness is 1,110 feet. The fill contains 2,000,000 yards of earth and rock, while the core-wall and spillway required 40,000 cubic yards of concrete.

A drainage area of 187 square miles contributes water, which will submerge 2,500 acres. The total cost was $4,215,000.

Water Rights Division Reports 1924-25 Busy Year

California Department Acts on Record Number of Applications to Appropriate Water

During the fiscal year ending June 30, 1925, the California Division of Water Rights received 606 applications, and acted upon 623, thereby reducing the number of pending cases from 874 to 857.

The 391 permits issued contemplate the appropriation of 13,807 cubic feet per second by direct diversion and 2,805,885 acre feet per annum by means of storage for the irrigation of 529,533 acres and the development of 815,662 theoretical horsepower.

Among the more notable agricultural developments for which applications were approved were those of Hot Springs Valley Irrigation District in Big Sage Drainage Area, Modoc County, Reclamation Districts 999 and 2068 in Sacramento Valley, Nevada Irrigation District in Nevada County, Camp Far West Irrigation District in Placer County and Oakdale and South San Joaquin Irrigation Districts in Stanislaus and San Joaquin Counties.

Among the more notable hydro-electric developments for which applications were approved were those of Nevada-California Power Company on Rush Creek in Mono County; Pacific Gas and Electric Company, on various tributaries of the Feather River and Butte Creek in Butte County; Nevada Irrigation District on various tributaries of Yuba River in Nevada County, Oakdale and South San Joaquin Irrigation Districts on Stanislaus River in Calaveras and Tuolumne Counties; J. W. Preston on Mokelumne River in Amador County, and Southern California Edison Company on San Joaquin River and tributaries in Fresno and Madera Counties. The last named project is one of gigantic proportions and one which probably sets record figures that will not soon be exceeded. The applications approved in connection with this single project contemplate the development of 559,410 theoretical horsepower at a cost of $80,000,000. It is expected that most, if not all, of the work mentioned above will soon be started, if it is not already under way.

Perris Reservoir Completed

The new half-million gallon reservoir of the city of Perris, California, has been completed and put in service. The reservoir is of reinforced concrete construction, eighty feet in diameter and sixteen feet deep. Coon Brothers, of Riverside, were contractors.

IRRIGATION MANAGEMENT

NEW MEXICO IRRIGATORS STUDY DISTRIBUTION

WAYS and means of improving present methods for the distribution of water from irrigation canals and laterals in New Mexico were considered recently at a meeting of prominent irrigationists at Las Cruces.

Representatives of the Farm Bureau, the Elephant Butte Irrigation District, the Bureau of Reclamation, and other interested parties participated in the discussion, which was called at the suggestion of L. M. Lawson, manager of the Elephant Butte irrigation project.

Numerous difficulties have recently been attending the management of irrigation water in this section, because of the largely increased acreage being put under cultivation. Because so much land under this project is being planted to cotton, it becomes essential that the water distribution be systematized so that every acre should have its due allotment of water when needed, and at the same time avoid confusion in water deliveries and costly ditch breaks.

MANY farmers in this district have complained that they are greatly handicapped on account of fluctuating heads. This is due almost entirely to the prevalent hit and miss system of delivering water at any time, to any water user, anywhere along the lateral, and to turning the water back into the main ditches at night. While night irrigation is not the most pleasant job in the world, it is absolutely necessary if fluctuating heads are to be avoided. It is also more economical as to labor and time, to irrigate continuously until through, and, in the heat of summer, night irrigation is more beneficial to nearly all plants.

Turning night water back into the laterals is also causing expensive ditch breaks, to such an alarming extent that the meeting readily agreed that something must be done about it at once. It was pointed out that farms along the ditches where such breaks are likely to occur must be protected, and the pocket books of farmers not directly damaged, must be protected also from the payment of consequent heavy damage claims.

Another matter of serious concern to the project, is the breaking of irrigation water into drainage canals. Of course, water intended for irrigation should ditches. The latter were constructed at tremendous expense to carry off seepage water, and if used for any other purpose cannot perform their proper function, without the expenditure of thousands of dollars of farmers' money to keep them in working condition. It does little good to spend $10,000 cleaning out a drainage canal, when, before the dredge has completed its work at the lower end, the upper end has again been washed full of dirt by irrigation water breaking in.

These points were thoroughly discussed at the Las Cruces meeting.

AT THE recent meeting of water users in the Elephant Butte Irrigation District, New Mexico, the means finally decided upon for the correction of some of their most pressing difficulties included:

1. To attempt to correct the evil of fluctuating heads by asking all irrigators to use their water continuously until through, and avoid turning it back into the laterals at night.

2. To require that the ditch-rider be notified at least 36 hours before water is wanted; the farmer to advise him how many acres are to be irrigated; and to require that the ditch-rider be notified before the end of the run in time to arrange for the next in line.

3. Each farmer to be given opportunity to irrigate as often as conditions on his lateral will permit.

4. Full discussion of all these problems before the local farm bureau organizations, with ditch-riders in attendance and taking part in the discussion.

IT was finally decided that the most practicable way to begin to correct the complaint of fluctuating heads, and to insure every acre of cotton and other crops its proper amount of water at the proper time, is to ask every farmer to use the water continuously, day and night, until he is through with it for each irrigation; the ditch rider to be notified at least 36 hours before water is wanted, the farmer to advise him how many acres he will irrigate, and the ditch rider to be advised before the run is finished, in time for him to arrange for the use of this water by the next in line; each water user to have opportunity to irrigate as often as conditions on his lateral will permit. It is believed that these simple and easy measures will accomplish much towards relieving the situation facing the farmers at the rapidly approaching peak of irrigation. But it will be necessary that the farmers and ditch-riders cooperate to the fullest extent to put even these simple plans into effective operation. To that end they will be discussed at all coming Farm Bureau Local meetings. Ditchriders will be invited to these meetings in order that the fullest discussion and understanding of the problems involved may be had.

Mr. Lawson, manager of the project, stated that he was not willing to attempt to establish any new system of water delivery unless the farmers themselves felt the need of it and were willing to assist him in improving the present distributing methods.

The question of filling drain ditches, it was pointed out, is one for the water users alone to decide. A continuation of the harmful conditions which have been prevalent means additional cleaning expense and ineffective drains and if the water users wish to keep operation and maintenance costs down as low as possible, they can aid in doing so by seeing that no irrigation water reaches the drainage canals.

Among those who attended the meeting beside Mr. Lawson, were F. J. Rigney, representing the Elephant Butte Irrigation District; J. F. Bennett and W. P. Thorpe, of the Farm Bureau; Paul A. Roach, local superintendent of irrigation; D. C. Caylor, project superintendent of irrigation; and V. G. Evans, chief clerk of the El Paso office.

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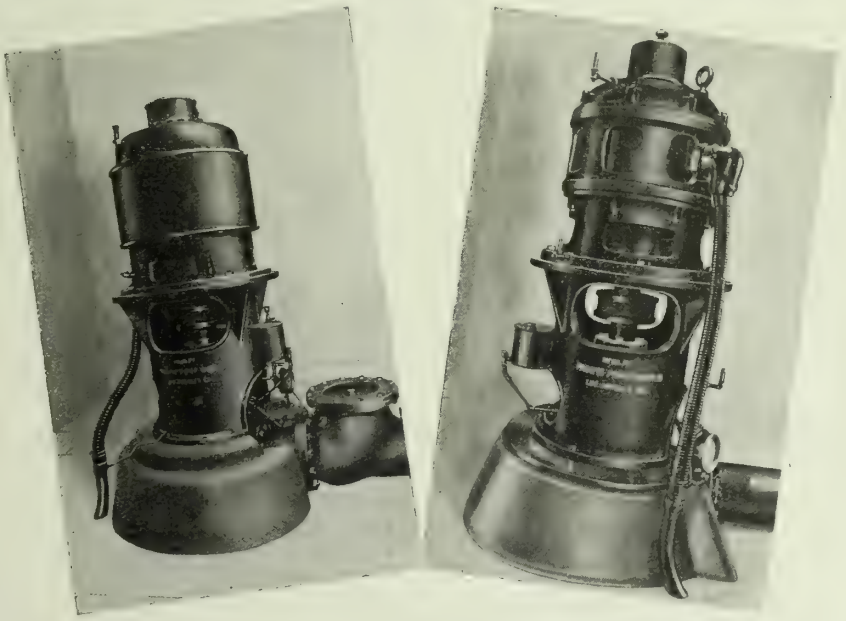

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Modern Irrigation's Advisory Board

(*Continued from Page 16*)

"The State has problems in engineering, and, particularly, in connection with its irrigation systems, that require men with wide irrigation knowledge and training. It has one of these in Wilbur F. McClure, who holds the office of Chief of the Division of Engineering and Irrigation.

"Mr. McClure has filled this office to the distinct advantage of the State. He was an engineer of wide, diversified experience before he entered the service of the State of California, and his handling of difficult work in that service has served to enhance his standing in the engineering profession, where he is highly regarded by those familiar with his duties. He was born in Ohio, spent his youth in Pennsylvania and came to California in 1883,—after spending some three to four years in assisting in the location and construction of several hundred miles of railroad in Missouri, Kansas, Arkansas, Texas and New Mexico.

"In California his work has been that of general practice, railway and municipal engineering, until Governor Johnson selected him as possessing those qualities needed in his present position, to which he was appointed in January, 1912. He has held the office to the entire satisfaction of all administrations ever since."

Edward Hyatt, Jr., is Chief of the Division of Water Rights of the State of California, before which office all new developments involving the use of water must come, as well as a great many old ones. Mr. Hyatt is a native Californian, a graduate of Stanford University with the degree of civil engineer, and prior to his connection with the State service was engaged in hydraulic engineering along irrigation and power lines in various parts of the State. The office of which he is the head was formerly known as the State Water Commission, consisting of three members. By successive legislative enactments the Water Commission was re-created as the Division of Water Rights, State Department of Public Works, the Chief of the Division being the executive head. Mr. Hyatt has been with the State Water Commission and Division of Water Rights since 1916 in various capacities, and was appointed as head of the office in 1924. His long association with the complicated legal and physical problems surrounding all California water matters has fitted him for the position he holds to a high degree and under his direction the office has made an enviable record of service during the past few years.

R. V. Meikle began his technical work in 1906 as a draftsman in the water department of the city of Portland. For six years he served in various capacities on city water supply, power and irrigation projects in the northwest, graduating from draftsman to instrument man, and from instrument man to assistant engineer. One year was spent with the U. S. Department of Agriculture in California, and in 1914 he was named chief engineer of the Turlock Irrigation District, which position he still occupies. In addition he is chief engineer of the Don Pedro project for the Modesto and Turlock Irrigation Districts, and chief engineer for the Merced Irrigation District in the construction of the Exchequer Dam, now under way.

The Cost of Irrigation Water in California

(*Continued from Page 12*)

acreage under irrigation is small compared to the pump capacity, or the plant is only run a portion of the time it might be operated. The irrigator may find it easier to run a large pumping unit for a few hours rather than to irrigate the same acreage with a smaller plant operating perhaps several days. But the interest on the capital invested in the excessively large plant and the increased amount that must be charged to depreciation and other fixed charges form considerable items in the total annual cost of irrigation water. In such cases the fixed charges generally amount to more than fifty per cent of the total annual cost. Fixed charges such as interest, taxes, insurance and depreciation go on continuously, whether the plant is operated or not. Some irrigators fail to realize this, and measure the cost of pumped water by the amount of their oil or electric power bills. Many power schedules have a demand or minimum charge which is paid whether the plant is run few or many hours.

In cases where a larger pumping plant has been installed than is needed to supply the acreage irrigated, the situation may be remedied if more land can be brought under irrigation. In some instances farmers have increased the number of acres covered by supplying neighbors with water. However, care should be taken not to sell water for profit, as private plants entering such services may be declared public utilities. In some sections of the state mutual water companies or unincorporated associations have been formed to reduce the overhead expense of pumping. The value of the crop grown is the potent factor that determines how high an irrigator can afford to pump water.

Equipment Men Meet in San Francisco

(*Continued from Page 24*)

conferences with the various power companies, the State Accident Commission and the Railroad Commission to the end that some uniform plan may be worked out that all manufacturers can follow in constructing their control boards, and that all power companies will approve when installed.

The California State Committee on the Relation of Electricity to Agriculture has suggested standard contract and specifications forms for pump manufacturers to follow. Pump manufacturers have a number of individual contracts and specification forms of their own now in use, and an attempt is to be made through the association to find some common ground for this form that will be acceptable to both manufacturer and user and equally fair to all.

The next meeting of the association is scheduled for September 11, in Sacramento, during State Fair week. Milton Ferguson, State Librarian, will be toastmaster, and J. E. Hintoon, president of The Peoples Bank of Sacramento and president of the California Bankers' Association, will speak.

"Peerless" in New Factory

The rapid development of the irrigation supply industry in California is evidenced by the recent removal of the Peerless Pump Company from its former headquarters at 826 Santa Fe Avenue, Los Angeles, to a commodious and modern steel building at 1902 East 67th street. In the new quarters, where two acres of land provide for future expansion as needed, the company has a producing capacity capable of turning out 100 pumps per month. Seventy men are employed in the new factory, where a total floor space of 8400 square feet is devoted to the producing end of the company's activities.

The Peerless Pump Company has proved itself an organization that grows as fast as an irrigated crop, for it had its beginnings only a little over two years ago, with a personnel of about a dozen men. It has extended its operations and territory to embrace the entire state of California, and in line with an aggressive policy of expansion will soon establish offices in other parts of the irrigation country.

Officers of the company are: President, E. M. Smith, prominent California industrialist and financier; Vice-President and Chief Engineer, J. A. Wintroath; Secretary, J. R. Sauerwein, and Treasurer, W. P. Custer. J. R. Gilbert is sales manager.

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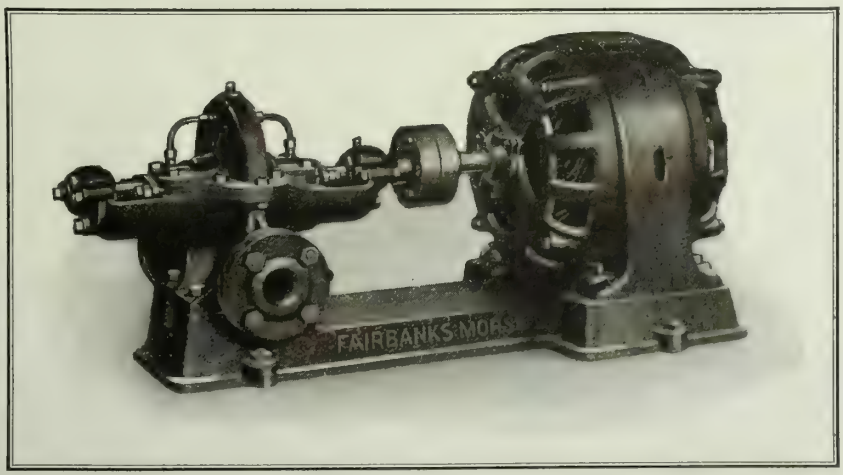

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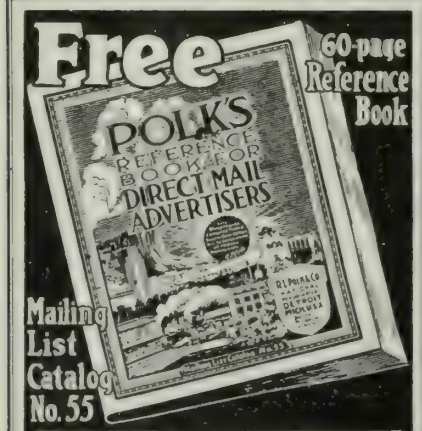

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What Conservation Means to You

(*Continued from Page 19*)

sumer. The late Secretary Wallace is quoted as saying that two-thirds of this waste could be saved by proper timbering methods. But that would involve some care and probably a slight diminution in the profits of someone between the owner of the tree and the ultimate user—and this loss of profit we seem unwilling to take in order to perpetuate our timber supply.

Fifty thousand fires annually destroy 10,000,000 acres; 150,000,000 acres of forested area in the south have practically no protection from fire at all, while it is stated on good authority that from three to four cents per acre per annum would give adequate protection to our forested areas and eliminate a large part of this tremendous loss.

Some people have the idea that reforestation is being carried on on quite an extensive scale in this country and that it will soon overtake the amount cut over and burned over so that a satisfactory balance may be had. The planting of redwood trees in northern California, by several of the large lumber companies, is a splendid demonstration of what can be done in the way of reforestation. Millions of redwood trees are being grown from the seed and these companies have a program of planting thousands of acres annually and hope eventually to have their planting equal their cutting. But when it is understood that the whole program of reforestation in the United States for the year 1924 was 36,000 acres that and we are cutting 10,000,000 acres annually, or reforesting less than fourtenths of one per cent of the area cut over, it will readily be seen how far we are from striking a satisfactory balance.

Of course, this does not mean that the 36,000 acres being reforested is the only young timber that is being grown, as there is a natural reproduction going on where timber is adequately protected from damage by fire.

BY WAY of comparison it may not be out of place to say that the little island empire of Japan had a reforestation program last year of 360,000 acres, ten times the amount being reforested in the United States. It will not do to say that labor is cheap in Japan and they can afford to have men do such work as this. Nature's laws do not take into consideration the cost of labor, but exact a penalty for every violation, whether it be by the individual or the nation at large.

Leaving out of the question the value of forests for recreational purposes, for the protection and perpetuation of game, for their influence on the health of the population, or their aesthetic value, let us consider for a moment the value of forests and brush for the conservation of water. Where watersheds are covered with trees or brush the precipitation, either in the form of rain or snow, is held in check and compelled to sink slowly into the ground to reappear in the small rivulets and streams which then flow perennially and regulate the flow of water in our small and eventually our great rivers. This means a uniform supply of clear water for domestic purposes and for irrigation, adequate water for navigation and a continuous supply of water for the development of hydraulic power which has recently become a necessity and enters into nearly every activity of life.

On the contrary, when timber and brush are destroyed on our watersheds the precipitation (in the form of rain or snow) when it melts, causes erosion, the filling up of small streams, high water, heavy damage from floods, amounting to hundreds of millions of dollars annually, lack of water supply for all of the purposes heretofore mentioned, distress, poverty and eventually depopulation. These statements may seem commonplace and something that everybody knows, but if they are, certainly knowledge on the part of everybody has not led to action that will prevent the destruction and loss of our timber and water supply with all of the consequent ills and distress which follow such loss.

THIS is a great economic problem, but it is too large a one to be solved by the individual or by any state. While it is an economic problem it is one that must be settled through political channels; that is, if it is ever to be solved satisfactorily, it must be by coordinated action by localities, cities, counties, states and, finally, the federal government, which should take the initiative.

How long are we, as a people, to proceed blindly and recknessly in the destruction of the remaining forested areas in the face of certain distress and disaster following such action? Do not dismiss this subject from your minds with the idea that it is the duty of the federal government or the state or county or city to take action. These are only the agencies through which the people of this country carry on their business. It is the business of every individual who has his own welfare, as well as the welfare of the country, at heart, to inform those in authority that action must be taken without delay to protect and perpetuate our timber and water supply.

For Detailed Listings, Branch Offices, Etc., See the Buyers' Guide to Leading Supply Sources—Pages 55-56

The Tractor Is Useful On Irrigated Farms

(*Continued from Page 13*)

with engines which are not too heavily loaded than with engines which are loaded to their maximum capacity.

POOR oil should never be used in a tractor engine even when the outfit is being used for field work or other jobs which do not demand a large amount of power or continuous operation. It is, of course, even more important that only the best oil be used when the engines must be kept at work twenty-four hours per day week after week. It is also more important in continuous work to inspect the fan belt once or twice each day to make sure that it has the proper tension and does not show any indications of breaking. Most tractors, when used for pumping, run without an attendant practically all the time, hence the need for watching such details as this in order to avoid having the fan belt start slipping or break and cause overheating of the engine when no one is at hand to stop it in case of emergency.

There are on the market some devices designed to stop an engine in case of overheating from any cause, before the pistons have seized or other serious damage has occurred. If there is any place where such attachments would be valuable, it is on an internal combustion engine being run continuously and with only occasional attention from the operator, such as when used for irrigating purposes.

It should be borne in mind that tractor engines were designed for use at work where an operator is in practically constant attendance, seldom more than the length of the drive belt from the outfit. When these machines are utilized for 24-hour-a-day service with only occasional attention from the operator, therefore, some extra precautions must be taken to prevent the oil from running low, fan stopping, etc., which would be very minor matters if they occurred when the operator was present, but may cause expensive delays and unnecessary repair bills if they occur when no one is present to give them proper attention.

THE COVER

The cover on this month's issue of MODERN IRRIGATION is a photographic study of the Don Pedro Dam, built in 1922 by the Turlock and Modesto Irrigation Districts, California. The Don Pedro is one of the most modern pieces of engineering construction in the west. Its length is 1,020 feet; its height 283 feet, and its cost was $4,864,824.

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HYDRAULIC ENGINEERING

Dealing with the Problems of the Irrigation Operating and Consulting Engineer

SOME ENGINEERING PROBLEMS OF WESTERN AGRICULTURE

By S. H. BECKETT

PROFESSOR BECKETT *is Associate Professor in Irrigation Investigations and Practice at the University of California, College of Agriculture. The accompanying article was presented by him before the recent convention of the American Society of Agricultural Engineers, and is published by special arrangement.*

AGRICULTURE under irrigation may be correctly referred to as one of the oldest industries. Scattered throughout the world, in Egypt, India, Southern Europe, China, Peru, Mexico and Southwestern United States, and dating back as far as 1700, B.C., are found the remains of an abandoned agriculture once highly developed and dependent upon irrigation. Whether the failure of these enterprises was due to engineering, economic or agricultural causes has not been satisfactorily explained. What ever the cause may have been, their existence is responsible for the statement that "it has yet to be proved that a permanent agriculture is possible under irrigation." Broadly speaking, the Irrigation problem of today is primarily agricultural; it is the problem of developing and maintaining permanent agriculture wherever irrigation is practiced.

However, no matter what the failures in the past may have been, or what may have been the cause, those of us interested in the engineering problems of irrigated agriculture look into the future with optimism. Failure of agriculture under conditions properly applied, as results of scientific investigations, has not been proven.

THE field of irrigation may be divided into three phases, irrigation engineering, irrigation economics, and irrigation practice. The irrigation engineering problems are those involved in the development and delivery of the water supply, based on safe engineering practice and at a cost which, under normal conditions of production, will assure the success of the project. The problems are strictly of an engineering nature, and although often demanding the highest engineering skill, are governed by established laws and practices, both in design and construction.

The problem of irrigation economics is one of determining, first, if the agricultural returns will justify the expenditure; and, second, of so financing the project that the water user will have at least an even chance to meet the obligations incurred by the development.

The agricultural phase, although generally assumed to be simple, chiefly because it is agricultural, is the phase of the development upon which the success of the project rests. Agriculture carries the financial burden of irrigation development. It is agriculture that must pay for construction costs as determined by the engineer, and under the conditions of payment determined by the economist.

Irrigation practice has been defined as "the artificial application of water to the land for the production of crops," and its problems are those which deal primarily with the development, transportation, and distribution of water on the farm, and its proper application to the crop.

IN THE development of private water supply, the prospective user either obtains water by gravity diversion from river or stream, or by pumping from open channels or wells. The design and construction of diversion works from open channels usually present no problems of a difficult nature. However, if the development involves the purchase of pumping machinery, the purchaser is immediately confronted with a series of perplexing problems of an engineering nature.

Conservative estimates place the number of irrigation pumping plants in operation in the United States at 25,000. California alone reporting the use of 21,000 individual plants in 1920.

The average irrigation plant is usually used in pumping from wells under lifts ranging from a few feet to a maximum of 350 feet; furthermore, these wells may be under conditions of seasonal fluctuating or gradually receding water table. Stored in the archives of pump manufacturing concerns, University, State and Federal offices are hundreds of tests of the efficiencies of these plants. Although in general these tests show low efficiencies, but little progress has been made in determining the causes of these low efficiencies or in finding a remedy for their improvement. The problem in pumping for irrigation is chiefly a problem of standardization—first, a standardization of methods and equipment for testing of wells, which will furnish information permitting the installation of proper equipment; and, second, if possible a standardization of the guarantee under which pumps are purchased.

In addition to this, more information is needed concerning the adaptation of various types of pumping machinery to varying conditions of lift, especially where definite information has been made available through a testing of the well. Finally, we should have available additional information concerning the economics of pumping. By this is meant; first, a careful analysis of conditions which warrant the purchase of pumping machinery; and, second, the economic capacity of the plant in view of the cost, the acreage to be irrigated, the period of operation of the plant and the cost of operation, especially under conditions of the "sliding scale" charge where electricity is used.

UNDER problems of water distribution on the farm may be included the following:

Design and construction of farm ditches.

Farm irrigation structures.

Measurements of irrigation water.

Seepage losses and ditch linings.

Design and construction of conduit systems of delivery, including the use of steel, wood stave, concrete and burned clay tile.

To the agricultural engineer the first three of the above present no problems of major importance. Improvement is always possible and such problems as more efficient machinery and better meth-

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What Richard Bard, President of the Zone Mutual Water Company, Ventura County thinks of

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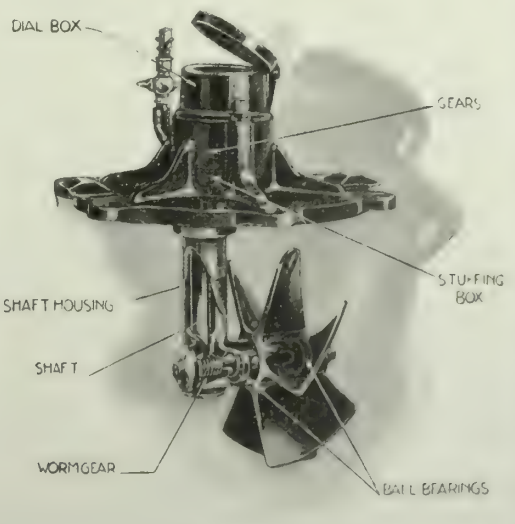

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ods of construction of farm ditches; standardization of design for farm irrigation structures and the adaptability of these designs to the various soil types in which the structures may be placed; simplification of methods of measuring water on the farm, especially under conditions of widely fluctuating heads, both in open channels and closed conduits, are all of sufficient importance to justify consideration.

The problems of seepage losses are not only important due to the economic loss through waste, but also are a constant menace to the water user. Ultimately water lost by seepage must be reclaimed by drainage. Measurement of these losses, although indicating the general extent of the loss, are of little use where they do not lead to preventive measures. Much valuable work has been done in a study of seepage losses and lining of large canals. This information should be made applicable to smaller ditches and laterals of the farm, especially in comparing their adaptability, cost and their efficiencies when compared to the underground delivery system.

IN THE design and construction of underground distribution systems on the farm, there is opened up to the agricultural engineer a practically untouched field for investigation and research. One western state alone reports an estimated installation of 1200 miles of concrete pipe per year. Although methods of manufacture are constantly being improved and recent years have shown very appreciable improvement in the quality of pipe manufactured, only limited investigations have been made to determine tensile strength, imperviousness and other qualities as developed under different methods of manufacture and curing.

The problems of pipe manufacture may be briefly listed as follows:

Investigations into methods of manufacture, including the selection, grading and mixing of materials.

Methods of curing new-made pipe.

Expansion and contraction of pipe, including effects of variation in soil and water temperatures, depth of laying, method of laying, use of expansion joints, etc.

Standardization of outlet structures including the design and installation of pressure stand, relief stands, delivery gates, division boxes, sand traps, etc.

Costs and adaptability of concrete pipe in comparison with the use of steel pipe, wood stave pipe, burned clay tile, or the lined open ditch.

Although these may be considered primarily as manufacturing problems, they are of importance to the water user, who, in the final analysis, is the one who profits if the installation is a success, and loses if the installation fails.

The problems in connection with the use of water on the land may be simply stated as follows:

1. Water requirements of irrigated crops, including the whole field of relation of plant growth to moisture supply.

2. Method of application, including the whole field of soil moisture movement.

3. Preparation of land for irrigation.

In other words this is a problem of, first, determining the economic water requirement of the crop to be irrigated including the proper time and frequency of irrigation; second, to determine the method of application which, under existing conditions, will permit the most uniform distribution of water through the soil mass; third, the proper preparation of land which will permit this uniform distribution.

Almost since the very beginning of modern irrigation practice, observations in the shape of so-called "duty of water investigations" have been made of existing uses and practices. Measurements, almost without number, have been made of quantities of water, both gross and net, which ditch companies and individuals have been using. The problem is not one of how much are they using, but how little should they use. If we hope to maintain a permanent agriculture on

Seventeen Rules to Remember

By G. E. P. SMITH

1. Keep the ditches in order. A sluggish current increases the water loss.

2. Line the ditches with concrete, or lay cement pipe lines. This settles the problem of seepage loss permanently and almost eliminates ditch maintenance.

3. Grade the land surface evenly. High places become "slick," low places invite watergrass, sun scald, and puddling of the soil. The "lands" should be level crosswise, but with adequate fall lengthwise.

4. Plow deeply. Deep-plowed soil utilizes all of the rainfall, takes the irrigation water more readily, forms a mulch quickly and permits better aeration.

5. Use short lands for light soils. The best length depends mainly upon the character of the soil, but also on the slope and on the head of water available.

6. Divide a large head of water into "unit heads" of such size as to give uniformity of irrigation throughout the length of furrow or land. If the upper ends of lands get too much water, divide the head into fewer lands or order a larger head; if the upper ends get too little, irrigate more lands at the same time. Larger unit heads are needed on lighter soils, flatter slopes, or longer lands or furrows.

7. Test the soil the day after irrigating to determine the depth of water penetration. Use a soil auger, a pointed rod, or a shovel. Ascertain if the water penetration is about right and whether it is uniform from end to end of lands or furrows.

8. Irrigate before planting. Have the soil well stored with water to a depth of 4 to 5 feet. Then allow a good root development before the next irrigation.

9. Do not overirrigate. An excess of water is an injury. Many crops do not require heavy irrigations. Even alfalfa can be given too much at a time.

10. Do not hesitate to irrigate at night. The big projects run water continuously. Why should not a pump irrigator also? The evaporation loss is much less at night. Pumping plants should be operated night and day through the hot growing months.

11. Irrigate at the most favorable time. Irrigate alfalfa when two-thirds grown, but not just after cutting; grains when just out of boot; and corn when in tassel and silk.

12. Examine the soil occasionally. Bore or dig into it at least 3 feet. Does it pack nicely in the hand? Irrigate when soil and crop indicate the need of water and not according to calendar. There should be always some reserve moisture in the soil to prevent wilting and to assure a profitable yield.

13. Cultivate. A loose soil mulch prevents baking and cracking of the soil and permits aeration of the roots. Cracks permit heavy losses by evaporation. Use an alfalfa renovator in August, in late fall, and in spring if alfalfa has been pastured. Row crops need cultivation after each irrigation, though in cases of cotton, corn, and milo cultivation is not possible in the latter part of the season.

14. Fight the weeds; eradicate them. Weeds rob the crop of water, sunshine, and plant food.

15. Rotate the crops; keep the soil fertile. Use alfalfa in the rotation; grow legumes and plow them under; all crop residues, straw, and stalks should be plowed under.

16. Do not irrigate the roads. Your neighbors do not appreciate this. Keep the gophers out of the ditch banks, shut off the water in time, and the highways will not become bogs.

17. Measure the water. Set a weir on your supply ditch. Are you getting as much water as you pay for? Do you know how much each crop is using? You measure everything else; why not the water supply?—*From Bulletin 101, Arizona Agricultural Experiment Station.*

our irrigated lands, water must be applied to meet the demands of the crop to be irrigated. The information needed can only be obtained by a fundamental study of the basic principles underlying the use of water by plants, determining first their theoretical requirements, and then as nearly as possible, meeting that requirement through improved methods of application.

IN CONSIDERING methods of application the problem is basically one of soil moisture movement. Theoretically a proper application of water demands that the effect of the mechanical composition of the soil on moisture movement be known. Observing water users have noted that the rate at which their soils absorb water is constantly changing. Why? What is the effect of existing moisture content on the rate of soil movement? To what extent does the volume weight and moisture equivalent of soil change under irrigation and is there an actual transportation of soil particles through the soil mass during irrigation? When we have answered these, we can more intelligently talk of irrigated methods, and more properly advise as to methods of preparation of land.

The above are but a few of the problems of present day irrigation practice. They are problems of agricultural engineering—that is, the science of engineering applied to agriculture. When we have solved some of them irrigation practice may be more simple.

Sec'y Work Visits Northwest

(*Continued from Page 22*)

The Portland *Journal,* in correspondence from Ontario, Oregon, greets Secretary Work's departure from the state "with mingled feelings of regret and relief in which relief predominates," and states: "He was hailed in Portland as a leader in the development of the west through reclamation . . . he passed over the Snake River bridge into a turbulent Idaho situation of his own creation, identified as an antagonist whose declared resistance must be overcome."

Editorially, the same newspaper comments: "By antagonizing the West as he has done in his recent visit, Secretary Work can only hope to bring to a pause the reclamation of lands through the agency of the federal government. That may be his desire. If so it is poor policy and poor politics." The *Journal* concludes: "No mere man, even in temporary official position, can stand against that march of progress to which the nation itself is keeping step."

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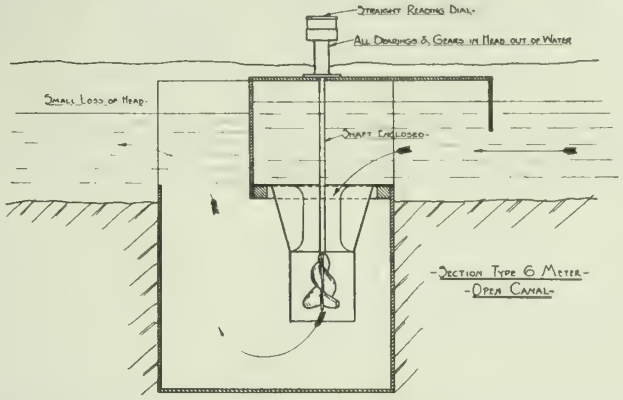
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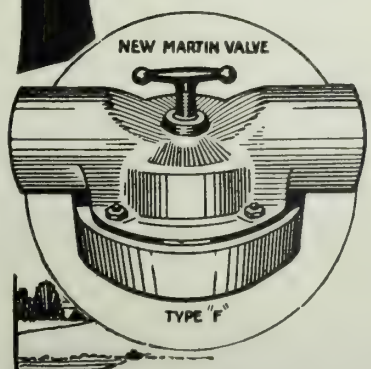

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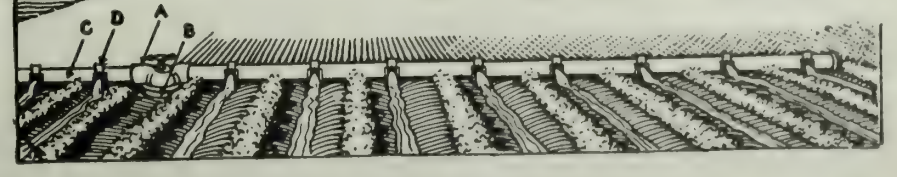

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WHO'S *WHO* AND WHO'S *WHERE*

IN IRRIGATION AND RECLAMATION

Personal Notes and Impersonal Observations About Men You Know

J. L. Savage, Designing Engineer of the Reclamation Service, was recently a visitor on the Salt River Valley project, Arizona. Mr. Savage expressed himself as much pleased with the engineering aspects of the entire project.

Offices of the Maricopa County Farm Bureau and the Arizona State Farm Bureau, in Phoenix, have been moved to Water Users' Building. County Agent Harry A. Stewart and Walter Strong, Secretary of the state federation, are to be found at the new headquarters.

Congressman Addison T. Smith, of Idaho, chairman of the house committee on irrigation and reclamation, while in Salt Lake during July expressed himself as confident of the future of reclamation, declaring that he believed settlers would be able to pay up their obligations fully if granted sufficient time.

Kirk Bryan, Geological Survey engineer, has begun an investigation of underground water resources for the State of New Mexico, pursuant to authorization made by the 1925 legislature. Mr. Bryan began reconnaisance of the field in July after a consultation with State Engineer George M. Neel at Santa Fe.

R. W. Sparling, of the Los Angeles firm of R. W. Sparling, has just returned from an extended trip through northern and central California. Mr. Sparling reports an excellent agricultural outlook throughout this region, wtih a continually growing demand for irrigation meters.

H. G. Miller has been appointed superintendent of the Imperial Irrigation District by the board of directors, replacing Paul S. Jones. Mr. Miller has been in the service of the district for more than ten years, and has advanced through the positions of zanjero, hydrographer, water master and assistant superintendent to his present post.

Max E. Cook, farmstead engineer of the California Redwood Association, formerly located in Los Angeles, has removed his headquarters to 24 California street, San Francisco, where he is organizing an Agricultural Department for the association. The department will make a farm building service available to lumber dealers, colonizers, farmers and other agricultural interests.

T. J. Dunnewald, director of soil surveys of the University of Wyoming, and W. G. Harper, soils expert of the Bureau of Reclamation, were recently in Saratoga, Wyoming, engaged in making a soil survey of the Saratoga irrigation project. If the Saratoga project is carried through as proposed it will open approximately 40,000 acres of new farm land in Saratoga and Encampment Valleys.

Charles C. Frisbie, the engineer who made the survey for the relocation of the "All-American canal" in the Imperial Valley, has been employed by the Imperial Irrigation District to survey the water usage of the upper Colorado River, with a view to protecting the rights of Imperial Valley water users. The Imperial district declares that excessive use of water on the upper part of the river is causing a serious shortage.

C. F. Zimansky, of the G. W. Price Pump and Engine Company, president of the Western Irrigation Equipment Association, has announced his intention of performing the impossible, and forgetting about pumps and irrigation for the period of about ten days. This noteworthy occasion is to be celebrated by a trip to the Yosemite Valley, a suitable reward for any man who is taking his first vacation in six years.

R. J. Coffey, district counsel for the United States Bureau of Reclamation, with headquarters at Berkeley, California, was in Klamath Falls, Oregon, during July, on business for the Bureau. He conferred with officials of the Klamath Irrigation District on the terms of a contract by which the district expects to take over its own operation and maintenance, now under the supervision of the Reclamation Service.

Arthur P. Davis, formerly director of the Reclamation Service, and now chief engineer of the East Bay Municipal Utility District, Oakland, California, has been asked by the Imperial Irrigation District to attend the conference of the Tri-state Colorado River Joint Commission, which meets at Phoenix in August, as their representative. Mr. Davis will represent other municipalities and organizations of Southern California at this session, as well.

George C. Kreutzer, director of reclamation economics, Department of the Interior, was one of a party of reclamationists which made a survey of the economic aspects of the Deschutes, Oregon, project, during July. Other members of the party were Herbert D. Newell, manager of the Klamath project, M. H. Lapham, soils expert, Department of Agriculture, Berkeley; Prof. Charles F. Shaw, University of Oregon; and Prof. W. L. Powers, Oregon Agricultural College.

Further indications of the reorganization policy undertaken by the Directors of the Imperial Irrigation District, in the interests of strict economy, have been evident during the latter part of July. The services of D. W. Murphy, well known Los Angeles consulting engineer, who was retained by the District as drainage engineer, and who has been successful in reclaiming lands of the district which had "gone alkali," were discontinued during the month in line with the general economy program. Still later the Directors voted to eliminate the office of chief engineer, held by Ray S. Carberry, and to request his resignation. The office of general manager was created to take the place of that of chief engineer, and, as reported by the press, Munson J. Dowd, formerly Head Watermaster, was named to this position.

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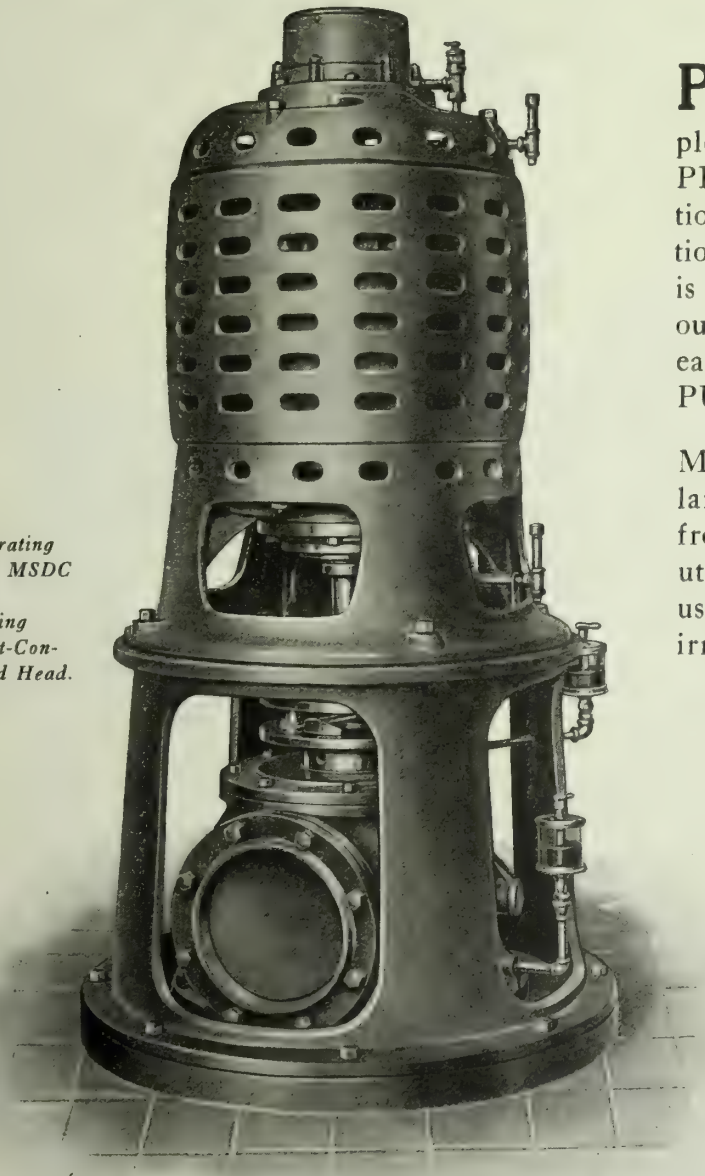

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RECLAMATION

ECONOMIC PRINCIPLES SHOULD GOVERN RECLAMATION

By DAVID WEEKS

Division of Rural Institutions, University of California

RECLAMATION of arid, swamp, flood and cut-over lands has been a subject of many controversies in Congress, in state legislatures and in numerous other official and non-official bodies. At present there are three reclamation policies in existence, each of which represents the point of view of a fairly large class of the American people.

One of the policies may be stated briefly—*"Reclaim no more land"*; another—*"Reclaim land, create financial machinery and reclaim more land"*; while the third group insists that reclamation development should be governed solely by supply and demand.

Senator McNary of Oregon, Chairman of the Senate Committee on Irrigation and Reclamation, will introduce in the next session of Congress a bill "To encourage the development of the agricultural resources of the United States through Federal and State cooperation". Under this measure any district in any state would be able to secure temporary financial aid from the Federal government for reclamation, provided state laws contain provisions whereby bonds may be issued by the district as a first lien on all the lands within its boundaries. The feasibility of the project would be determined by the Secretary of the Interior, subject to review by Congress. The *Country Gentleman* has uttered a war cry against Senator McNary in a full page editorial in its issue of May 23 and is publishing a number of articles apparently aimed at his reclamation policy.

FEASIBILITY is the keynote of the proposed legislation and upon this word hinges the success or failure of the Senator's bill. *Feasibility* has within its five syllables all that engineering, agricultural and economic investigations can determine, and then some.

Feasibility is dependent upon physical factors such as soil, drainage, water supply and workmanship of constructon.

Feasibility depends upon climatic factors such as rainfall, length of growing season, and range of temperature.

Feasibility most of all depends upon economic factors, and upon economic principles rests the future not only of each individual project but the successful administration of the whole plan. The first cost of raw land is not as important as the cost of its agricultural development. Costs of construction, costs of preparing land for irrigation and cultivation, costs of building houses and barns, costs of buying livestock, costs of buying equipment and costs of planting and bringing crops into production form one important group of economic questions to which we have not given proper consideration in the past but which must be considered in the determination of feasibility.

MARKETING and transportation facilities, crop adaptation, costs of production and gross returns—not only cost of production and gross returns today but for the years to come—must be estimated in the determination of *feasibility*. Costs of production and gross returns over a long period of time are a complex study and are closely related to the operation of the law of supply and demand. If this were a simple law of nature, it could be examined by experimental processes. The whole study is, however, complicated by paucity of information, by human emotions, fickleness, changing desires and prejudices. One of its most disturbing features is its slowness of operation.

When prices are high, there is a *tendency* for a smaller quantity of a product to be consumed and for greater quantities to be produced. Periods of high prices are periods of agricultural expansion. When prices are low, the opposite *tends* to be the result. Tendencies, however, are often upset for a time by disturbing influences. A low price of dairy products will often result in many farmers adding to their herds in order to bring their income up to its former level. After a time one dairyman after another will change from dairying to some other type of farming or will discontinue farming entirely. On the other hand many farmers will hesitate for a time to build new dairy barns to take advantage of a rise in price. The response gradually takes place, however, and there is an increase in supply. This is only one type of instance illustrating the prevalence of influences which disturb the operation of the law of supply and demand. Numerous other instances could be given of this retarded response of supply to price change.

These irregularities are much more pronounced in regions where agricultural production is largely on reclaimed lands, as it is in the west. As a rule in reclaimed areas agriculture is more intensive. Crops are more permanent in character. A period of high prices which indicates an increased demand is followed in the first instance by an expansion of the area under irrigation. Many new projects are organized during this period, but the construction is spread over a period of four or five years. Perhaps by the time water is available prices have gone down, but the lands within the irrigation projects must be developed or be confiscated by the overhead charges brought about by the new construction.

AS A RESULT thousands of acres of trees, vines, and alfalfa are planted which, by the end of three or four years, come into full bearing. Alfalfa, of course, does not take so long, but it does take time for the new farmer under irrigation to purchase necessary equipment and livestock. Thus, about nine or ten years after development has been started by the demand impulse or maximum prices, only part of the lands have been brought under full production. Much of this development is carried on during years of depression in the face of negative public sentiment in regard to agricultural expansion. A large part of the lands, due to high costs of development in proportion to current prices, wait for another

(Continued on Page 40)

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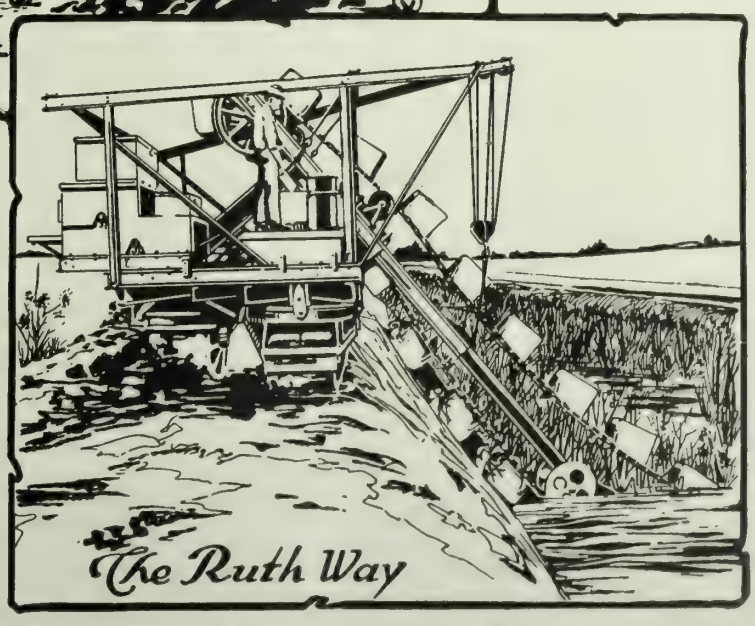

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VOTE BONDS TO COMPLETE GREAT TEXAS PROJECT

FORTY thousand acres of land in Texas, lying in Bexar, Medina and Atascosa counties, comprising Medina Irrigation District No. 1, will be supplied with water through the completion of the original Medina project, as the result of a unanimous vote by residents of the district, authorizing the issue of $2,500,000 in bonds for that purpose.

The Medina Irrigation District was formed fifteen years ago, Dr. F. S. Pearson, of New York, being the moving instrumentality in conceiving the plan and putting the first steps into execution. The Medina Dam, at Medina Lake, was completed in 1912, and shortly after this the further development of the district was delayed by the European War. Dr. Pearson had interested English capital in the completion of the project, and was on his way to England on the Lusitania when it was sunk by an enemy submarine. His death and the interruption occasioned by the war was a severe setback for the project. Subsequently the companies organized to carry on the work were thrown into a receivership, and work came to a standstill.

As the result, however, of the recent authorization of bond issues amounting to $2,500,000, the project will be carried out substantially as originally planned. Additional canals and laterals will be constructed without delay, which will bring water to all of the 40,000 acres in the tract, and the ambition of the first organizers of the district will be on the way to realization.

UNDER the new project, the 40,000 acres of fertile land in the district will be taken over by five trustees, who will operate the farm lands solely with a view to selling them.

The irrigation of the farms will be under the management of the Medina Valley directors. With the taking over of the farm lands and the irrigation project, the Medina Valley Irrigation Co. and the San Antonio Land & Irrigation Co. will go out of existence.

These companies have been in the hands of Hugh Robertson, federal receiver. Mr. Robertson about a year ago was appointed receiver for the companies interested in the development, and plans were begun to carry through the project.

The main dam at Medina Lake is 164 feet high. From it the water runs to a diversion dam, and from the diversion dam it is sent into flumes and canals which carry it to the fields of corn, cotton and truck. It is estimated that the land in the area will be worth $25,000,000 after the work has been completed. The irrigation district will be capable of supporting from 10,000 to 15,000 persons.

There are now only about 250 tenants in the area.

Although there are slightly more than 40,000 acres in the district now, engineers declare that the dam and its canals can be made to supply 60,000 acres.

The diversion dam, four miles below the main dam, is 500 feet long and 48 feet high. The main canal, carrying water from the diversion dam is 24 miles long.

PRACTICALLY every acre of the tract to be brought under irrigation is arable, and the water from Medina Lake will be distributed to the area by gravitation and entirely independent of pumps.

"There is not a single acre that can not be irrigated by gravity, the water flowing through canals from the lake in the hills to the acreage 25 to 30 miles removed, reaching every single acre by gravity," officials of the project declare.

The holdings of the companies which were in the receivers' hands were to be sold at foreclosure, the present bondholders buying in the properties and in turn selling them for the $2,500,000 in bonds.

Only about 8,500 acres are at present under irrigation, but additional canals and laterals necessary to care for the entire tract will be constructed. Crops on the area now under irrigation are flourishing.

The variety of the soil and topography in the tract makes the proposition a general one, with parts peculiarly adapted to truck, fruit and general farming.

At the recent election which approved the bond issue to complete the project, every vote cast was recorded in favor of the proposition. Of seventy-one eligible settlers who were privileged to cast votes, sixty-one appeared at the polls and voted in the affirmative.

The first work to be begun under the extended project is the completion of the plan for extending the main irrigation canal and building the laterals which will make water available for the entire area of the project. This will require an expenditure of approximately $720,000 and is now going forward.

The refunding and enlarging plans of the project have been worked out with the approval of the financial interests holding the outstanding securities of the district, and the officials of these companies have expressed satisfaction at the prospect of carrying the project to a successful culmination. The new land irrigated by the enlarged project will be distributed to actual settlers, in tracts averaging about forty acres each.

Reclamation and Economics

(*Continued from Page 38*)

cycle of high prices to be brought under cultivation. This retarded development has resulted in the financial distress of thousands of farmers and failure of many irrigation enterprises.

BECAUSE of these complex irregularities a plan might be suggested which is a modification of the attitude toward letting development drift along in a rather haphazard fashion in response to supply and demand. Such a plan would contemplate a careful study of the operations of this and other economic laws with a view to meeting crises before they occur.

In California we are endeavoring, by the investigation of actual rural conditions, to develop a practical method of economic analysis of agriculture and agricultural lands under irrigation. There is much yet that we do not know; but one by one we are eliminating the uncertain factors upon which *feasibility* depends. As the work continues in this and other states, divergent ideas like those of Senator McNary and the editor of the *Country Gentleman* will be reconciled. In the light of more economic knowledge, these two policies could be merged and coordinated with a modification of the one placing sole dependence upon supply and demand. This should bring about a sane reclamation policy which is economically sound.

The training of professional men equipped with an understanding of these difficult problems, the education of the public, especially those directly concerned in agriculture and reclamation development, concerning the purpose and need of special knowledge of this kind, will do much to prevent unwise and ill-timed development and yet permit of a wholesome expansion of our agricultural resources.

Water Power Figures

The developed water power of the world in 1920 was about 23,000,000 horsepower, according to an estimate made by the United States Department of the Interior in 1921, through the Geological Survey. At the end of 1923, according to the best information available, it was about 29,000,000 horsepower, an increase of 26 per cent in about three years.

Pump Irrigation for Desert Lands

(*Continued from Page 14*)

THE MOJAVE Desert is within a radius of 50 to 150 miles of a population of 2,000,000 people in San Bernardino, Orange, and Los Angeles counties, California; it is traversed by railroads, and, for the greater part, good highways; it has excellent soil and a good climate, and quite extensive studies have been made, by the United States Geological Survey and by the State of California, of the ground waters. The several bulletins published on the subject are most instructive and interesting.

Senator Shortridge will introduce a bill in the next session of congress, asking for an appropriation sufficient to purchase drilling rigs and to operate them for a period of at least three years. The general plan of operation will be to select several widely separated areas over the Mojave Desert, and to drill wells to the water tables underlying them. Pumping tests will be made to determine the water production of the wells, and this data will be a part of the records in the United States land office. These records will assist the homesteader in determining the shallower water areas.

IN AREAS where it is found that water is too deep for economic water lift, drilling will cease, and the rigs will be concentrated on those areas where more favorable water conditions exist. In time the deep water areas will be determined and abandoned, and a reasonable number of wells drilled in the shallower water areas. We must always bear in mind that the water underlying the Mojave Desert is not inexhaustible. The water is limited, and should not be drawn on beyond the recharge supplied by the run-off from the mountains and the slight amount of water that sinks into the ground from the annual precipitation on the desert. If too many wells are pumped in any area the water table will be lowered below the economic water lift, and the whole district will suffer in consequence. It is not simply the depth to water that is important, but the quantity of water available in a particular area that must be considered. The number of acres that can be irrigated will depend upon the quantity of water to be found at a distance below the surface that will justify pumping for irrigation.

A definite and detailed plan whereby the homesteader will reimburse the government for the cost of drilling wells has not been worked out. Probably the homesteader will be allowed to make annual payments for a period of ten years or longer. The same plan will also be extended to include the drilling of wells on lands already proved up. The cost of these wells, in this way, will be returned to the government, and the drilling of wells will be extended to other desert territories.

THERE are approximately 1,200,000 acres of vacant government land remaining in the Mojave Desert, Antelope Valley, and the arms running out from them. Probably ten per cent of this area can ultimately be reclaimed by pump irrigation. The remaining ninety per cent will be a problem for some future generation to solve. I will say in passing, however, that, with the increasing demand for land, year by year, we hope to see the indigenous plants developed and improved until a considerable acreage can be put to a useful purpose without irrigation—or with very little irrigation. We believe important results could be accomplished if an experiment station were established, at some point in the Mojave Desert, where the Department of Agriculture and the State of California could experiment with the native desert plants.

If we are to extend the irrigated areas of the Mojave Desert, by pump irrigation, it will require industrious and careful effort. If this project is to succeed hard-headed practical methods are necessary. Every drop of water pumped must be put to its most useful purpose; and care must be taken to plant only such crops as will require the least water for the greatest market value. The careless farmer will never succeed on the desert.

We are hoping that Congress will make an appropriation to drill wells over the Mojave Desert. We have the utmost faith in the success of the project, and in a few years hope to see thousands of acres brought under cultivation, where many of our citizens will be made independent and happy—with "a piece of land" all their own.

APPROVE RIVER STUDY

Officials of the Sacramento and San Joaquin River Problems Conference and the California State Division of Water Rights have approved plans for continuing the study of the water problems of these two California rivers during the coming year. The work of the conference was begun last year at the instance of transportation interests and water users, and involves keeping a record of water diversion for irrigation purposes and a close study of water duty. A scientific study of evaporation will be conducted during 1925 as well.

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IRRIGATION FINANCE

ADEQUATE FARM LOANS FOR IRRIGATED LANDS

2. Financing Lands Under Established Projects

By B. J. SEGER

In the July number of MODERN IRRIGATION *Mr. Seger discussed the problem of securing farm loans for lands under new irrigation projects. The following article is the second of a series, and is devoted to methods of organizing to secure loans under older and well-established irrigation projects.*

IT SHOULD not be so difficult to secure loans on lands under established irrigation projects as under new projects, for the reason that practically all of the land is under cultivation and has been cropped long enough to demonstrate its productivity. There has been time to level the land, enrich the soil, and build an adequate system for distributing the water to the land in the most economical manner to the individual farm. The seepage, if any, has had time to develop, and necessary drains have been provided for its disposition. Considerable money has been expended in one kind of improvement or another.

An experienced land appraiser would be in position to recommend an amount that would be safe to loan on the land, provided the amount of bonded or construction debt and floating debt were not too heavy per acre and provided the owner was not too heavily encumbered otherwise with high interest bearing debts. The appraiser would also want to know the plan for repayment of the bonded or construction debt—whether the payments would eventually be in excess of the economic limit of the land to pay.

IF IT were found that the yearly per acre payment was so large that it would require all the average net returns from the land to pay the yearly charge, then no matter how well the farm was located nor how productive, he could not advise his loan company to make loans on lands under the project carrying too heavy a yearly per acre charge. It is, therefore, just as important that careful consideration be given to the financial condition of the older projects as that of the new projects. It is also just as important to make sure that the canal system is in a good state of repair.

It might be advantageous and advisable to refinance the project, refunding the present bond issue into a serial bond spread over as many years for repayment as needed to reduce the payments to a point where the yearly payments can be easily met. It may be that there is a large floating debt such as warrants, running for two to three years before payment, as well as other indebtedness bearing a high rate of interest.

IT IS important, if an irrigation district is to be successfully refinanced, that the irrigation laws provide that an irrigation district may fund its warrants into a bond ssue when advantageous to do so. A short time serial bond could be issued to take up the warrants and other floating indebtedness, the bonds sold and the district placed on a cash basis. There would be no necessity for making an extra levy for a funding bond issue, for the reason that levies have been made for all outstanding warrants, which are in the form of unpaid taxes.

Even with the finances of the district placed in the best possible condition, loan agencies are not willing to make loans on such lands under some projects because of a rather high bond or construction debt per acre.

Then again, there are about fifty per cent of the lands on irrigated projects farmed by tenants, and such owners cannot secure loans from the Federal Land Bank. The Joint Stock Land Bank will not make loans on irrigated land at the present time, and other loan agencies are slow in coming into irrigated territory to make loans.

It would seem, therefore, that some way should be provided for the fifty per cent of landowners who are not in position to avail themselves of the Federal Land Bank loans to secure loans locally on practically the same terms. It is important that the tenant also be taken into consideration in making provision for securing loans at a low rate of interest.

The first plan of securing additional credit which I wish to consider is that of organizing an Agricultural Credit Corporation. I would consider this plan practical only for larger irrigation projects. Such a corporation can be organized with five or more persons, and is very much the same as any corporation, in its organization and purpose, with the exception that it is under the supervision of the United States Comptroller of Currency and that the organization must be approved by him. Provision is made in the Federal Land Bank Act for such a corporation. An Agricultural Credit Corporation can be organized with a paid up capital of $10,000.00, but it is recommended that the Corporation be organized with a paid up capital of $250,000.00, for the reason that the corporation would be in position to begin making loans at once, while if the corporation were to be started with the smaller capital, but few loans could be made at the start. This type of corporation operates in some respects like a bank—it may discount notes, warehouse receipts and other paper, and may borrow money at a rate not to exceed the legal rate for the State.

Inasmuch as the Agricultural Credit Corporation is for the purpose of assisting the farmer, all loans must be for agricultural purposes—the purchase of livestock and building improvements. If sufficient funds could not be raised from the sale of stock in the beginning, the same plan could be used which was mentioned for new projects, that of securing the loan of the credit of the State for funds equal to the amount of paid up capital. The loans made by the Agricultural Credit Association should be for from one to three years with approved security. Such an organization should include considerable territory, such as an entire county or a large project having from fifty to one hundred and fifty thousand acres of irrigable land. An organ-

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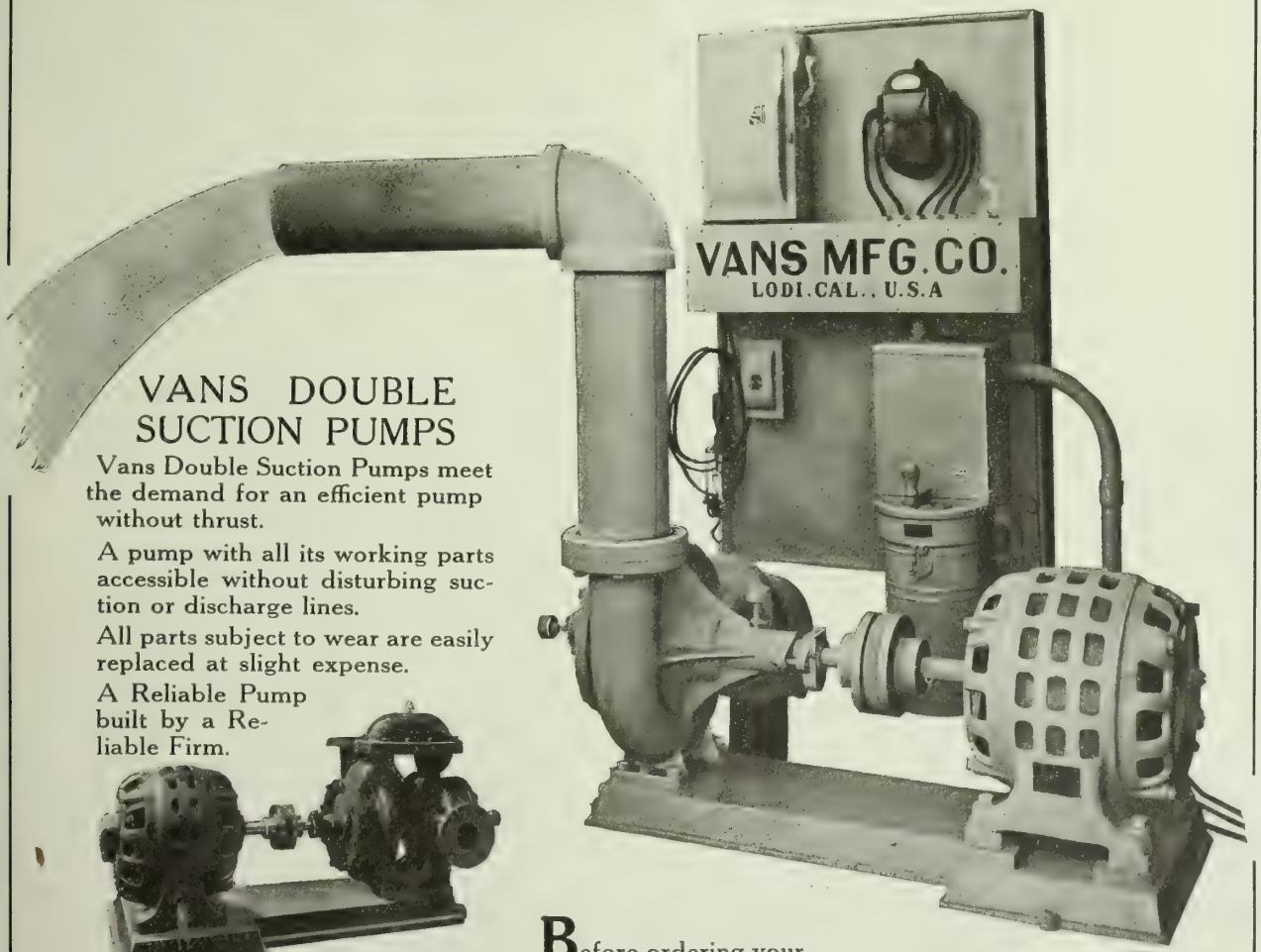

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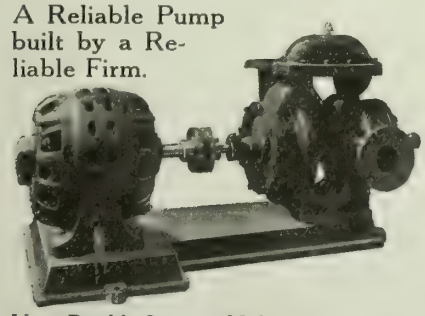

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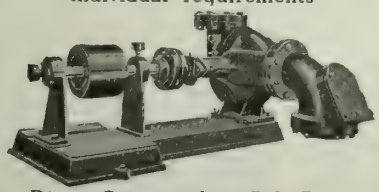

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ization of this kind, if well established, and after it had gained a credit standing with the Federal Reserve Banks, would have no difficulty in securing funds for loan purposes.

ON RECLAMATION projects, not only the credit of the State might be secured, but also that of the Government. Reclamation funds might be loaned for this purpose. That fund receives one million dollars per month from the sale of public lands and oil leases in western States. It would be entirely reasonable to ask that the Government loan to its own Reclamation projects, where an Agricultural Corporation or a Mutual Loan Association had been properly organized, an amount equal to the paid up capital of the organization—on the dollar matching plan.

With the money borrowed from the State or the Reclamation fund as the case might be, added to that received from the sale of stock, funds would be available in a comparatively short time, ample for loan purposes. When the loans and interest began to be repaid, a revolving fund could be built up, to such an amount that all of the stockholders could be granted loans sufficient for their needs.

The enactment into law of the new Reclamation Bill, known as the "Fact-finders Bill," has brought new hope and courage to landowners under reclamation projects. It would be a most opportune time for landowners under reclamation projects to organize an Agricultural Credit Corporation or a local loan agency of some kind. There is no question but that a strong organization could be built up in a few years which would be of material help to the entire community.

A second plan would be the organization of a Mutual Loan Association. An organization of this kind would be more satisfactory for the smaller projects, or landowners on several of the smaller projects might join together and organize on Agricultural Credit Corporation which would serve the needs of all.

With an organization of the kind best adapted for the community, to assist the landowner on irrigation projects in securing one to three year loans at 5 to 6 per cent for the purchase of livestock or improvements, the landowner would, in a few years, be on a first-class financial basis.

IT MIGHT be desirable for some of the landowners to secure loans running over a long period of time before repayment. Such landowners could not do better than to avail themselves of the Federal Land Bank loan or loans of a similar nature having the amortized feature and carrying a low rate of interest.

No project can be an entire success, no matter what the plan of financing may be, unless some definite system is established for the collection of irrigation taxes each year. The present law of Nebraska provides that an irrigation district board may refuse to deliver water to landowners who owe more than one year's tax. Many irrigation districts in the west require that the irrigation tax be paid before water is turned to the land. This plan seems to be the best for all concerned, it would tend to keep such district on a cash basis, and the landowners would be saved a considerable amount each year in interest and discounts if taxes were collected when due.

To one selling securities of an irrigation district, it is apparent that district boards must in the future make definite and sustained effort to collect irrigation taxes or irrigation securities will be considered by financial organizations as too great a risk for safe investment. Should such organizations take this view of irrigation securities it would tend to bring about financial disaster to districts whose boards are lax in collections, which would also reflect discredit on all irrigation district securities.

The irrigation law in Nebraska provides a remedy where taxes are not paid when delinquent—the tax sale and the foreclosure. Tax sales bring in money to the district but the individual landowner suffers in the payment of 12 to 15 per cent interest. No land owner can pay that interest for any length of time and succeed in his farming operations. A district having many tax sales each year would be looked upon by purchasers of securities as unsafe. It would be difficult to secure a loan on lands on which there were tax sales; it would indicate the owner's inability to pay.

SOME irrigation districts have made a special effort to collect one year of tax each year before water is turned to the land. The officers of these districts feel well repaid for the effort made, and it is quite certain that they would not think of relaxing in their efforts to secure the payment of taxes. They feel that the time is past when a landowner should continue to receive water, year after year, if he makes no effort to pay his taxes.

These districts have found that it has made a marked difference in the item of the sale of warrants. Such districts, which have been making an effort to collect taxes, found that their warrants sold readily at a good price while warrants of districts making no effort to collect, although no further behind in the payment of warrants, were a drug on the market.

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OVERHEAD IRRIGATION

CITRUS INSTITUTE DISCUSSES SOIL MOISTURE

PROBLEMS of irrigation in general and overhead irrigation in particular received a great deal of attention at the Fourth Annual Southern California Citrus Institute, which met at Anaheim recently.

A varied program of papers and reports dealing with many phases of the economics of citrus culture had been worked out to make a well-rounded appeal to the more than four hundred growers and citrus workers who gathered for the two-day session; but the questions of irrigation were among the most interesting of those discussed.

Harold E. Wahlberg, Farm Advisor of Orange County, in delivering the first paper of the meeting, touched briefly on the high lights to be developed in more detail in subsequent discussions. He dealt with irrigation as one of the six essentials to successful citrus fruit culture, discussing it under the head of "soil moisture control."

"Too many of us," declared Mr. Wahlberg, "in the past have been inclined to consider orchard irrigation practice as separate and apart from other phases of tree management, but as we investigate the many conditions confronting individual trees and groups of trees we find that soil moisture control or irrigation practice is closely associated with available soil fertility, tree diseases, wind protection, cultivation and even pest control.

"EXCEPT for the first essential, a tree of good parentage, I would place soil moisture control next in importance because of its close bearing on the other essentials, and the question of soil moisture control is one of economics. The cost of water is influenced by the amount used at each application and throughout the year. If we are using 25 to 50 per cent more water than is actually needed to penetrate the three or four feet of root zone, then we are extravagant in the amount of water used. Not only that, but the cost of pumping is increased, the wear and tear on the machinery, the extra fuel charge, and greatest of all is the loss through leaching of the soil fertility. The valuable plant foods that are necessary for tree life are in soluble form. The portion of these soluble plant foods in the soil is materially affected by the movement of water. If we carry these solutions down below the root systems of the trees we are materially cutting down the amount of foods available to the trees. This is particularly true in the lighter soils and in the loam soils.

"Now, how about the heavy clay and adobe soils? The same axiom quoted above holds true except in a different way. If the heavier soils are kept continually saturated with moisture the roots become inactive, sluggish, soil flora and bacteria become inactive and in extreme cases the roots will rot. Roots in this condition of course cannot supply the necessary food solution to the tree and as a consequence tree growth stops, leaves turn yellow and finally defoliate.

"Every soil and every orchard presents a problem of its own in determining the proper method of distribution of water and it behooves the grower to study more closely the behavior of moisture penetration in his particular soil which can only be done by means of trenching or boring with a soil auger and shovel. We have been too much concerned with the upper half of the tree and have in many cases neglected the conditions affecting the lower half of the trees which is below the surface of the ground."

THE principal feature of the discussion of overhead irrigation was contributed by Professor H. A. Wadsworth, of the University of California. Professor Wadsworth is assistant in the Division of Irrigation Investigations and Practice of the College of Agriculture, and has been working for several months in a thorough-going research study of the relation of overhead irrigation to soil moisture conditions.

His paper was the first official statement that has been made since the beginning of the investigations, and was consequently greeted with great interest.

Introducing his paper Prof. Wadsworth pointed out that "interest in overhead sprinkling as a means of orchard irrigation has developed with amazing rapidity in southern California during the past two years," and spoke briefly of the efforts made by such agencies as the weather bureau, packing houses, and the state university to study some of its problems. The message of his paper was primarily a plea for a more scientific study of overhead irrigation in all its aspects, in order that its advance should be free from distorted and exaggerated claims of its advantages.

"ALTHOUGH no conclusion can be drawn from the work at this time," said Prof. Wadsworth, speaking of the experiments which are being made under his supervision with sprinkler systems, "we have some indication that a satisfactory soil moisture condition may be maintained by sprinklers." This is his summary of the work undertaken by his department:

"The Division of Irrigation Investigations and Practice of the College of Agriculture has undertaken to determine the moisture distribution which results from overhead sprinkling as practiced on two of the common citrus soils of Los Angeles and Orange Counties.

"Before the details of the procedure of these investigations be discussed it is essential that one have a clear conception of those principles of soil moisture distribution which are active when a soil is wetted either by natural rainfall or by artificial means. It will be recalled that the amount of water a soil can hold against the downward pull of gravity varies with the fineness of the individual particles that go to make up the soil mass. The decomposed granites of the Sierra Madre Foothills are remarkably low in their water holding capacities since the individual particles are relatively large. The soil of the Whittier and La Habra area are much more finely divided; their water holding capacity is consequently far greater.

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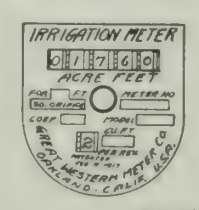

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"With this conception of the soil moisture relations the problem of determining the effectiveness of irrigation by overhead sprinkling resolves itself into a series of soil sampling operations throughout the normal irrigation season. If such samplings demonstrate that sprinklers can be relied upon to wet any soil to the depth of the feeding roots in a reasonable period of application, without excessive losses by surface runoff and without surface erosion or compacting it can be claimed that sprinkler irrigation is effective in creating and maintaining a desirable soil moisture content.

"In the investigations indicated above six groves have been selected for intensive soil moisture studies. Three of these lie on the decomposed granite soils of the Sierra Madre Foothills; three lie in the new zone of sprinkler development, on the clay loams of the La Habra and Montebello areas.

"Four sets of samples have now been taken from the six groves and subjected to our usual soil moisture analysis. The last samples were taken immediately before and immediately after an irrigation in order that the effect of the irrigation upon soil moisture increases might be noted without the necessity for correcting for losses between the date of irrigation and the date of sampling. Although no conclusion can be drawn from the work at this time we have some indication that a satisfactory soil moisture condition can be maintained by sprinklers upon the two soils under consideration. To accomplish this result it has become apparent that some care must be used in determining the duration of run and the frequency of application. But with careful management and with frequent use of the soil auger and shovel sufficient penetration can probably be secured with the most difficult soils.

"The effect of continuous year in and year out irrigation by sprinklers upon the physical condition of these heavy soils can only be conjectured. We have no evidence that compacting of the sur-

face will result nor have we evidence that the continuation of this practice will not increase the impervious nature of these heavy soils and render their management more difficult."

Prof. Wadsworth dealt briefly with the problems of evaporation, fertilizer distribution, pest and disease control, temperature control, and the relation of sprinkling to the quality of the fruit, pointing out, in each case, that while great advantages have been claimed in relation to these factors by enthusiastic irrigators, there is a need for a careful and scientific investigation of the whole subject.

IN CONCLUSION he discussed sprinkler economics, declaring:

"Sprinkler installations are costly especially when a permanent installation is desired in locations where pressure is not available and where a booster pump must be resorted to. Economic justification for such a system can only be secured when cash values are given to each of the benefits to be gained by the proposed system and when the sum of the annual benefits exceeds the carrying charges on the system.

"Credit for many of the advantages of overhead sprinklers may easily be expressed in dollars and cents. The cost of furrowing out and the labor of applying the water which are items of saving by sprinklers are easily computed. Such advantages as uniformity of fertilizer distribution, and the probable improvement in the quality of fruit produced under sprinklers can be only roughly estimated in cash value.

"The carrying charges for such a system can be closely computed. It is fair to assume, I believe, that twenty years is the probable life of a modern sprinkler installation. During every year a sum of money should be laid aside which is equal to one-twentieth of the capital investment. Within twenty years the original capital will be returned to the owner. Interest charges should also be considered and the system should each year pay interest at, say, 6 per cent on that part of the capital investment which has not found its way into the sinking fund. In this way the annual carrying charges decrease annually during the life of the system. To this carrying charge must be added maintenance charges and replacement costs.

"By this analysis the annual cost of operating a sprinkler system can be determined. If this average annual cost is greater than the sum of the cash value of the benefits the system is not economical and the difference must be charged to convenience of operation."

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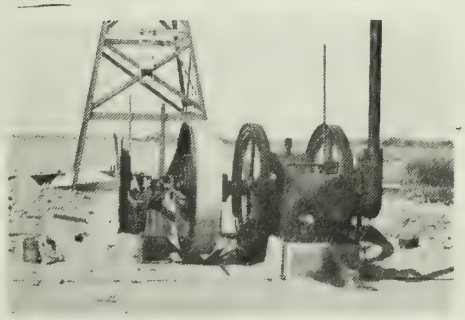

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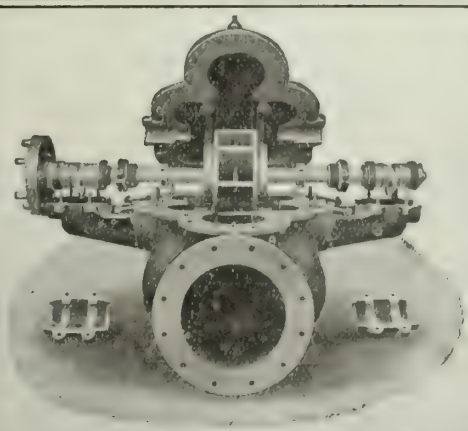

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As Shown by Official Records of the Month -- Local, State, and Governmental

OFFICIAL RECORDS PROMISE BIG-SCALE ACTIVITY

AMONG the permits to appropriate water issued by the Department of Public Works, Division of Water Rights of California during the month of June, 1925 were the following:

Permit No. 2114, Application No. 3575 (San Bernardino County). Issued to Bertram W. Jack, Los Angeles, Calif., June 8, 1925, for 0.20 cubic foot per second from an unnamed canyon in Sec. 9, T 2 S, R 1 W, for domestic use and irrigation of 160 acres in Section 7 and 8. Estimated cost $10,000.00.

Permit No. 2117, Application No. 4355 (Sutter County). Issued to Eliza Smith, Berkeley, California, June 19, 1925, for 5.57 cubic feet per second from Sacramento River in Section 15, T 14 N, R 1 E, for irrigation of 366 acres near point of diversion. Estimated cost $1000.00.

Permit No. 2118, Application No. 4144 (Del Norte County). Issued to Ed. Hight, Smith River, Calif., June 22, 1925, for 1 cubic foot per second from Morrison Creek in Section 36, T 18 N, R 1 W, for domestic use and irrigation of 80 acres in Section 25. Estimated cost $1000.00.

Permit No. 2119, Application No. 3687 (Calaveras County). Issued to Frank Becker, West Point, Calif., June 23, 1925, for 6 cubic feet per second from Licking Fork in Section 18, T 6 N, R 14 E, for power purposes in Section 18, propose to develop 75 T. H. P. Estimated cost $1000.00.

Permit No. 2120, Application No. 2992 (San Diego County). Issued to the City of San Diego, San Diego, Calif., June 24, 1925, for 1200 acre feet per annum from Flume Nine Creek in Section 28, T 17 S, R 3 E, for municipal purposes in city of San Diego. Estimated cost $1,300,000.00.

Permit No. 2121, Application No. 2993 (San Diego County). Issued to the City of San Diego, San Diego, Calif., June 24, 1925, for 1800 acre feet per annum from Rattlesnake Creek in Section 33, T 17 S, R 3 E, for municipal purposes in city of San Diego.

Permit No. 2122, Application No. 2994 (San Diego County). Issued to The City of San Diego, San Diego, California, June 24, 1925, for 2,000 acre feet per annum from Tunnel Two Creek in Section 5, T 18 S, R 3 E, for municipal purposes in City of San Diego.

Permit No. 2123, Application No. 2995 (San Diego County). Issued to The City of San Diego, San Diego, California, June 24, 1925, for 2,000 acre feet per annum from Matchin Creek in Section 12, T 18 S, R 2 E, for municipal purposes in City of San Diego.

Permit No. 2124, Application No. 3186, (Humboldt County). Issued to Charles Martin, Blocksburg, California, June 24, 1925, for 0.025 cubic feet per second from Conley Creek in Section 21, T 2 S, R 5 E, T.M. for irrigation of 25 acres in Section 28. Estimated cost $1,000.00.

Permit No. 2130, Application No. 4170 (Contra Costa County). Issued to R. W. Newell, Walnut Creek, California, June 26, 1925, for 0.5 cubic foot per second from Walnut Creek in Section 34, T 1 N, R 2 W, for irrigation of 50 acres near point of diversion. Estimated cost, $1,000.00.

Permit No. 2132, Application No. 4149 (Santa Barbara County). Issued to K. C. Wallace, Los Angeles, California, June 29, 1925, for 0.34 cubic foot per second from two small streams in Section 24, T 11 N, R 30 W, for domestic use and irrigation of 60 acres in Section 13. Estimated cost $2,000.00.

Permit No. 2135, Aplication No. 3500 (Butte County). Issued to George B. Champlin, et al, Red Bluff, California, June 30, 1925, for 16.37 cubic feet per second from Sacramento River in Section 1, T 23 N, R 2 W, for domestic use and irrigation of 1310 acres near point of division. Estimated cost $26,000.00.

Permit No. 2137, Application No. 4289 (Los Angeles County). Issued to Richard Dvorak, Littlerock, California, June 30, 1925, for 0.15 feet per second from underground water to be developed in Section 17, T 4 N, R 10 W, for domestic use and irrigation of 40 acres in Section 8. Estimated cost $1,000.00.

Permit No. 2139, Application No. 4409 (Siskiyou County). Issued to J. L. Jones, Edgewood, California, June 30, 1925, for 200 acre feet per annum from Shasta River in Section 25, T 43 N, R 5 W, for irrigation of 152 acres near point of division. Estimated cost $5,000.00.

Permit No. 2142, Application No. 4291 Sacramento County). Issued to Ralph Moore, Sacramento, California, June 30, 1925, for 1.75 cubic feet per second from Sacramento River in Section 26, T 7 N, R 4 E, for irrigation of 140 acres near point of diversion. Estimated cost $1,000.00.

Permit No. 2143, Application No. 4292 (Sacramento County). Issued to Mrs. Annie Hack, Sacramento, California, June 30, 1925, for 2.50 cubic feet per second from Sacramento River in Section 13, T 7 N, R 4 E, for irrigation of 200 acres near point of diversion. Estimated cost $2,000.00.

APPLICATIONS

Among the applications for permit to appropriate water filed with the State Department of Public Works, Division of Water Rights, (California) during the month of June were the following:

Application No. 4612 (Sonoma County)—G. T. Rickman, c/o, Floyd D. Darby, Healdsburg, California, for 0.19 cubic foot per second from Mill Creek, tributary to Dry Creek, to be diverted in Section 30, T 9 N, R 9 W, M.D.M., for agricultural purposes on 15 acres in Sections 30 and 31, T 9 N, R 9 W, M.D.M Estimated cost, $1,000,00

Application No. 4613 (Sutter County)—Percy T. Hincks, Yuba City, California, for 0.5 cubic foot per second from Sacramento River, tributary to Suisun Bay, to be diverted in Section 16, T 14 N, R 1 E, M.D.M., for agricultural purposes on 40 acres in Section 15, T 14 N, R 1 E. Estimated cost, $17,500.00.

Application No. 4614 (Humboldt County)—Michael R. Morres, Orleans, Humboldt County, California, for 2½ cubic feet per second from Wilson Creek, tributary to Klamath River, to be diverted in Section 17, T 11 N, R 6 E, H.M., for mining purposes in Sections 19, 29 and 30, T 11 N, R 6 E, H.M. Estimated cost, $10,000.00.

Application No. 4616 (Trinity County)—Karl Albiez, Hayfork, Trinity County, California, for 1.12 cubic feet per second from Hayfork Creek, tributary to South Fork Trinity River, to be diverted in Section 11, T 31 N, R 12 W, M.D.M., for agricultural purposes on 90 acres within Sections 10 and 11, T 31 N, R 12 W, M.D.M. Estimated cost, $1,500.00.

Application No. 4617 (Ventura and Los Angeles Counties)—A. D. Schindler, 1104 Balfour Bldg., San Francisco, for 200 cubic feet per second and 75,000 acre feet per annum from Piru Creek, tributary to Santa Clara River, to be diverted in Section 30, T 7 N, R 18 W, Section 3, T 6 N, R 18 W, Section 34, T 5 N, R 18 W, S.B.M., for agricultural purposes in Valleys of Bucks and Santa Clara River between Piru and Fillmore.

Application No. 4618 (Ventura County)—A. D. Schindler, 1104 Balfour Bldg., San Francisco, for 200 cubic feet per second and 111,800 acre feet per annum from Sespe Creek, tributary to Santa Clara River, to be diverted in Section 6, T 5 N, R 22 W, Section 36, T 6 N, R 20 W, Section 2, T 4 N, R 20 W, S.B.M., for agricultural purposes in Valleys of Sespe Creek and Santa Clara River between Fillmore and Saticoy.

Application No. 4619 (Ventura County)—A. B. Schindler, 1104 Balfour Bldg., San Francisco, for 200 cubic feet per second and 101,000 acre feet per annum from Sespe Creek, tributary to Santa Clara River, to be diverted in Section 6, T 5 N, R 22 W, and Section 36, T 6 N, R 20 W, S.B.M., for generation of hydro-electric energy.

Application No. 4620 (Ventura and Los Angeles Counties)—A. D. Schindler, 1104 Balfour Bldg., San Francisco, California, for 200 cubic feet per second and 75,000 acre feet per annum from Piru Creek, tributary to Santa Clara River, to be diverted in Section 30, T 7 N, R 18 W, Section 3, T 6 N, R 18 W, S.B.M., for generation of hydro-electric energy.

Application No. 4627 (Napa, Solano, Lake Counties)—C. A. Tusch, 2211 Union Street, Berkeley, California, for 400 cubic feet per second and 300,000 acre feet per annum from Putah Creek, tributary to Sacramento River, to be diverted in (direct) Section 26, T 8 N, R 2 W; (storage) Section 29, T 8 N, R 2 W, Section 13, T 11 N, R 6 W, M.D.M., for agricultural purposes on 60,000 acres in T 7 and 8 N, R 1 W, and T 7 and 8 N, R 1 and 2 E, M.D.M.

Application No. 4628 (Santa Barbara County)—Union Sugar Co., c/o McKinstry Haber & Firebaugh, 703 Market Street, San Francisco, California, for 10.54 cubic feet per second from San Antonio Creek, tributary to

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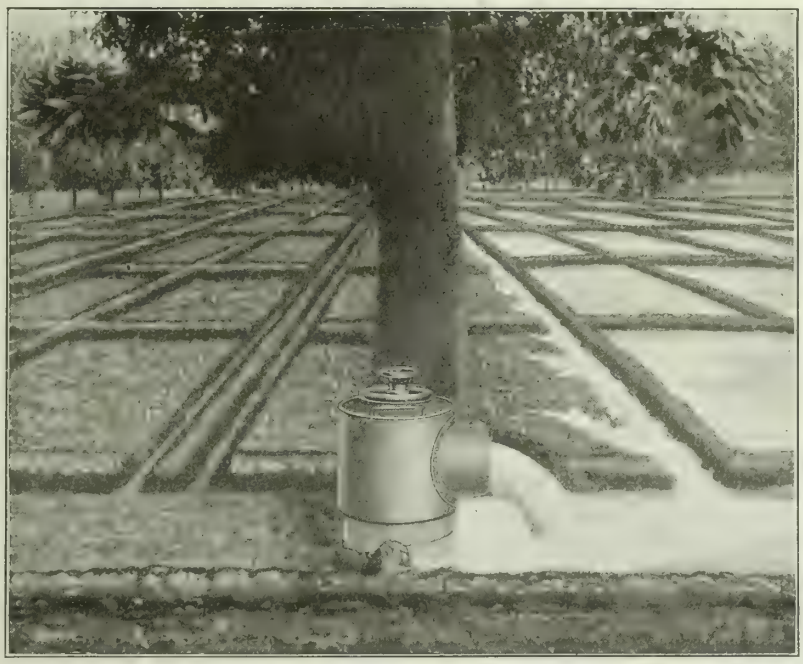

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Pacific Ocean. The points of diversion lie between Sta. 1 and Sta. 170 on San Antonio Creek, to be diverted from (1) NW Corner, T 8 N, R 34 W, to (2) Section 8, T 8 N, R 35 W, S.B.M., for agricultural purposes on 843 acres within Sections 8, 15, 16 and 17, T 8 N, R 35 W, S.B.M. Estimated cost, $3,000.00.

Application No. 4629 (Butte County)—A. G. Eames, Trustee Butte Creek Project, Chico, California, for 500 cubic feet per second and 100,000 acre feet per annum from Butte Creek, tributary to Sacramento River, to be diverted in Section 4, T 21 N, R 2 E, M.D.M., for agricultural purposes on 40,000 acres within T 22 N, Rs 1 E and 1 W, T 21 N, Rs 1 and 2 E, T 20 N, Rs 1 and 2 E.

Application No. 4630 (Trinity County)—James B. Knight, Fred M. Kay, J. L. Stone, W. H. Haw, Frank Breeden and David Wilson, c/o James B. Knight, 304 DeYoung Bldg., San Francisco, California, for 62.5 cubic feet per second from New River, tributary to Trinity River, to be diverted in Section 33, T 7 N, R 7 E, H.M., for generation of hydro-electric energy within Sections 35, T 6 N, R 6 E, H.M. Estimated cost, $55,000.00.

Application No. 4635 (Contra Costa County)—Alfred S. Ferguson and William C. Ferguson, c/o Ohm & Raab, 517 E. Market Street, Stockton, California, for 12.21 cubic feet per second from Old River and Western Canal, tributary to San Joaquin River, to be diverted in (1) Section 20, T 1 S, R 4 E, (2) Section 29, T 1 S, R 4 E, M.D.M., for agricultural purposes in Sections 19, 20, 29 and 30, T 1 S, R 4 E, M.D.M. Estimated cost, $11,000.00.

Application No. 4636 (San Joaquin County)—Mrs. Anna Bautz, c/o Ohm & Haab, 517 East Market Street, Stockton, California, for 2.00 cubic feet per second from Middle River, tributary to San Joaquin River, to be diverted in Section 13, T 1 S, R 5 E, M.D.M., for agricultural purposes on 160 acres within Sections 13 and 24, T 1 S, R 5 E, M.D.M.

Application No. 4637 (San Joaquin County) Caroline Moran, c/o Ohm & Raab, 517 East Market Street, Stockton, California, for 12.44 cubic feet per second from Middle River, tributary to San Joaquin River, to be diverted in Section 23, T 1 S, R 5 E, M.D.M., for agricultural purposes on 995.5 acres in Sections 10, 15 inclusive, 22 and 23, T 1 S, R 5 E, M.D.M. Estimated cost, $9,000.00.

Application No. 4640 (Kern County)—H. E. Seaton, 3004 Council Street, Los Angeles, California, for 0.5 cubic foot per second of underground water, tributary to Sand Canyon, to be diverted in Section 8, T 25 S, R 38 E, M.D.M., for agricultural purposes on 40 acres in Section 10, T 25 S, R 38 E, M.D.M. Estimated cost, $3,000.00.

Application No. 4643 (San Diego County)—La Mesa, Lemon Grove and Spring Valley Irrigation District, c/o Thomas H. King, 920 Eight Street, San Diego, for 5.0 cubic feet per second and 100,000 acre feet per annum from San Diego River, tributary to Pacific Ocean, to be diverted in Section 7, T 15 S, R 2 E, S.B.M., for agricultural purposes on 20,000 acres.

Application No. 4647 (Fresno County)—San Joaquin Light and Power Co., Fresno, California, for 720 cubic feet per second from North Fork of Kings River, tributary to Kings River, to be diverted in Section 12, T 12 S, R 26 E, M.D.M., for generation of hydro-electric energy in NW ¼ of Section 11, T 12 S, R 26 E, M.D.M. 33136 T.H.P., to be developed. Estimated cost, $1,850,000.

Application No. 4648 (Fresno County)—San Joaquin Light & Power Co., Fresno, California, for 220 cubic feet per second, from North Fork of Kings River, tributary to Kings River, to be diverted in Section 6, T 11 S, R 28 E, M.D.M., for generation of hydro-electric energy in NW ¼ of Section 6, T 11 S, R 28 E, M.D.M., 6250 T.H.P. to be developed.

Application No. 4649 (Fresno County)—San Joaquin Light & Power Co., Fresno, California, for 220 cubic feet per second from North Fork of Kings River, tributary to Kings River, to be diverted in Section 3, T 12 S, R 27 E, M.D.M., for generation of hydro-electric energy in NE ¼ of Section 12, T 12 S, R 26 E, M.D.M., 61,875 T.H.P. to be developed. Estimated cost, $10,222,179.00.

Application No. 4650 (Fresno County)—San Joaquin Light & Power Co., Fresno, California, for 220 cubic feet per second from North Fork of Kings River, tributary to Kings River, to be diverted in Section 1, T 11 S, R 27 E, M.D.M., for generation of hydro-electric energy in SE ¼ of Section 34, T 11 S, R 27 E, M.D.M. 53,000 T.H.P. to be developed. Estimated cost, $9,571,840.00.

Application No. 4651 (Fresno County)—San Joaquin Light & Power Co., Fresno, California, for 220 cubic feet per second from North Fork of Kings River, tributary to Kings River, to be diverted in Section 10, T 12 S, R 26 E, M.D.M. Generation of hydro-electric energy in NW ¼ of Section 19, T 12 S, R 26 E, M.D.M. 10,500 T.H.P. to be developed.

Application No. 4662 (San Joaquin County)—Mrs. Susie Moran, c/o Ohm & Raab, 517 East Market Street, Stockton, California, for 1.24 cubic feet per second from Grant Line Canal, tributary to San Joaquin River, to be diverted in Section 26, T 1 S, R 4 E, M.D.M., to be used for agricultural purposes on 99.2 acres in Sections 23 and 26, T 1 S, R 4 E, M.D.M. Estimated cost, $1,500.00.

Application No. 4665 (Butte County)—Gorrill & Hotchkiss, 1050 Esplanade, Chico, California, for 15 cubic feet per second from Butte Creek, tributary to Sacramento River, to be diverted in Section 7, T 20 N, R 2 E, M.D.M., for irrigation of rice, 1200 acres in Sections 7, 8, 17, 19, 20, 29 and 30, T 20 N, R 2 E, M.D.M. Estimated cost, $1,500.00.

OREGON

The following list includes the more important applications as filed in the office of Rhea Luper, State Engineer, of Oregon, for the last month for which records are available:

M. J. Lee, Trustee, of Canby, covering the appropriation of water from Molalla River, and two unnamed streams tributary thereto, and Pudding River for irrigation of approximately 3,000 acres and development of power in Clackamas County.

E. H. Hinton of Lewis, covering the appropriation of water from Chesninimus Creek for irrigation of 11 acres in Wallowa County, at a cost of $500.

City of Astoria covering the appropriation of water from Youngs River for development of 200 theoretical horsepower, and for a municipal supply for the city, in Clatsop County, at an estimated cost of $200,000.

Harry Sordy of Merlin, covering the appropriation of water from Rich Gulch for development of 5 theoretical horsepower for mining in Josephine County, at a cost of $1,000.

John Allstead, A. C. Brown, and H. C. Foster of Halfway, covering the appropriation of water from Pine Creek for irrigation of 40 acres in Baker County, at a cost of $200.

City of Clatskanie, covering the appropriation of water from Conyers Creek for municipal purposes for the city, at a cost of $20,000, in Columbia County.

F. F. McCready of Chiloquin, covering the appropriation of water from Sprague River for irrigation of 218 acres in Klamath County, at a cost of $2,000, and also covering the appropriation of unknown flood wash for irrigation of 60 acres in Klamath County, at a cost of $400.

Baar & Cunningham of Portland, covering the appropriation of water from Calapooia Creek for domestic purposes in Douglas County, at an estimated cost of $60,000.

Wilson R. Winans of Hood River, covering the appropriation of water from Inlet Creek for irrigation of 30 acres, development of 15 theoretical horsepower, and for domestic purposes in Hood River County.

Howard Evans of Freewater, covering the appropriation of water from Eagle Creek for development of power in Baker County.

Ralph H. Springsteen of Ashland, covering the appropriation of water from Keene Creek for irrigation purposes in Jackson County.

Geo. W. Stewart of The Dalles, covering the appropriation of water near bank of Chenowith Creek for irrigation of 1 acre, domestic and stock purposes in Wasco County, at a cost of $500.

E. E. Billings of Marial, covering the appropriation of water from Rocky Bar Creek for irrigation of 6½ acres in Curry County at a cost of $500.

Davis & Fretwell of Leland, covering the appropriation of water from Butte Creek Fork for mining purposes in Josephine County, at a cost of $1,000.

Power Developments

Eleven applications for permit or license under the Federal water power act were filed with the Federal Power Commission during the seven weeks' period ended July 11, 1925, making a total of 625 applications received to that date. The following are the applications received from west of the Mississippi River:

No. 614—The Southern California Edison Company has applied for a license for a transmission line in Ventura County, California, a small portion of which is on Government lands.

No. 615—Walter G. Muncy has applied for a license for a small power development for domestic and camp use in Kelly's Gulch, about 19 miles from Crescent City, Del Norte County, California.

No. 616—The Great Western Power Company has applied for a license to increase by 45 feet the height of an existing dam in the North Fork of Feather River, near Greenville Plumas County, California. This will add one milion acre feet to the storage capacity from Lake Almanor and will regulate the flow of water in the river now used through the Company's existing Caribou and Big Bend power plants.

No. 619—The Feather River Power Company has applied for a license to construct a 106-foot dam on Bucks, Grizzly, and Milk Ranch Creeks, in Plumas County, California. A reservoir with a capacity of 103,000 acre feet will be created and the project will have an approximate primary capacity of 60,000 horsepower, intended for general sale.

No. 621—The Inland Power & Light Company has applied for a preliminary permit covering the construction of a power project in Clearwater River, about two miles above

Lewiston, Nez Perce County, Idaho. The power to be developed will be for general sale.

No. 622—The Ventura Power Company has applied for a preliminery permit for a power installation consisting of two reservoirs and three power units, with appurtenant structures, in Sespe Creek, Ventura County, California. The dams will be 200 and 240 feet high and will impound 63,500 and 10,800 acre feet of water, respectively. The developed power will be used for general sale.

No. 623—The Ventura Power Company has applied for a preliminary permit for a power installation with a primary capacity of approximately 25,000 horse-power, in Ventura and Los Angeles Counties, California. The project will comprise a reservoir of 22,000 acre feet capacity behind a 200-foot multiple-arch type dam at the junction of Bucks and Piru Creeks, and another reservoir on the latter creek near Los Alamos Creek with a capacity of 53,000 acre feet behind a 210-foot dam, tigether with three power houses and other appurtenant works. The power to be developed will be for general sale.

No. 624—The Southern Sierras Power Company has applied for a license for a short transmission line near Wilde, Victorville and Oro Grande, San Bernardino County, California.

No. 625—The Jo Reynolds Mining, Milling, Drainage, Tunnel and Transportation Company has applied for a license for its constructed power project in Clear Creek County, Colorado. The primary capacity of the plant is about 112 horsepower, used for mining operations.

New Incorporations

The following new water companies have been incorporated in California during the last month for which official records are available:

No. 114448—SOUTH VALLEY MUTUAL WATER CO. (a California company). Directors: Chas. Goodhue, Josiah Main, Geoffrey Fricker, Chas. Ott, and L. T. Schwacofer, all of Hemet, Cal., (each one share). Date of filing, June 4, 1925. Place of business, Hemet, Riverside County. Capital stock, $25,000. Par value, $100. Amount subscribed, $500. Purposes—To furnish water to its stockholders at cost for domestic and irrigation only on the following land: west ¾ of section 18 and 19, township 5 south range one east S. B., B & M. and sec. 13, 14, 23 & 24 of township 5 south range one west S. B. B. and M. Articles filed by Bruce W. McDaniel Legal Dept., Mutual Orange Distributors, Redlands.

No. 114477—LA CUMBRA ESTATES MUTUAL WATER CO. (a California company). Directors: Homer D. Crotty, Ira C. Powers, Malcolm Davis, all of Los Angeles; Geo. Arblaster, South Pasadena; J. C. Macfarland, South Pasadena, (each one share). Date of filing, June 6th, 1925. Place of business, Los Angeles. Capital stock, $205,000. Par value, $100. Amount subscribed, $500. Purposes—to supply water to stockholders only for domestic and irrigation. Articles filed by Gibson, Dunn & Crutcher, 1111 Merchants National Bank Building, Los Angeles.

No. 114487—PASADENA TERRACE MUTUAL WATER CO. (a California company). Directors: Warren H. Kerr, Los Angeles; E. S. Patterson, Glendale; Noren Eaton, Whittier, (each one share). Date of filing, June 8, 1925. Place of business, Los Angeles. Capital stock, $10,000. Par value, $50. Amount subscribed, $150. Purposes—to supply water for domestic purposes to its stockholders on tract of land known as Tract 7446, County of Los Angeles as per map record in Book 47, pages 21 and 22 of Maps of County Recorder's office, Los Angeles. Articles filed by Moote & Patterson, 830 H. W. Hellman Building, Los Angeles.

No. 114644—FAWNSKIN WATER COMPANY, (a California company). Directors: J. S. Waybright, Howard C. Thompson, and F. R. McArthur, all of Los Angeles, (each one share). Date of filing, June 18, 1925. Place of business, Los Angeles. Capital stock, $75,000. Par value, $10. Amount subscribed, $30. Purposes—to sink and maintain wells and supply water to municipal and private corporations and individuals for domestic and irrigation use. Articles filed by Theodore Stensland, 226 Black Building, Los Angeles.

No. 114740—TOPANGA OAKS MUTUAL WATER CO., (a California company). Directors: Walter H. Prier, Bundy Drive and Gorham Ave., west Los Angeles; Mor M. Fogel, 507 Palisades Ave., Santa Monica; Ralph C. McCague, 1337 Third St., Santa Monica, (each one share). Date of filing, June 27, 1925. Place of business, Santa Monica. Capital stock, $1500. Par value, $1. Amount subscribed, $3. Purposes—to furnish water for domestic purposes to owners of land in tract No. 6943, County of Los Angeles. Articles filed by Fogel & Beman, Santa Monica.

No. 114805—MERIDIAN MUTUAL WATER CO., (a California company). Directors: C. C. Nordal, R. L. Farnsworth, E. O. Eggen, G. P. Hill, R. W. Anderson, all of Hemet, (each one share). Date of filing, July 2, 1925. Place of business, Hemet. Capital stock, $10,000. Par value, $10. Amount subscribed, $50. Purposes to operate wells and pumping plant and distribute water to its stockholders.

No. 114870—WEST GATEWAY MUTUAL WATER CO., (a California company). Directors: Gordon Edward, R F D, Box No. 3; Wilson E. Profitt, Ralph C. Milner, R. B. Smith, all of R F D, Box No. 3, Whittier; A. A. O'Quinn, Montebello, (each one share). Date of filing, July 8, 1925. Place of business, Los Angeles. Capital stock, $5,000. Amount subscribed, $25. Par value, $5. Purposes to furnish water for domestic purposes only to its stockholders and to the owners of lots constituting and comprising Tracts 6614 and 6767, Los Angeles. Articles filed by D. M. Potter, 511 Chapman Bldg., Los Angeles.

Survey Uinta Basin

To provide a means of estimating the possible extent of development of resources of the Uinta Basin, Utah, which are dependent on water supply, and of planning the best methods of development, an investigation has been made by the Department of the Interior, and a report of this investigation entitled "Water supply of Uinta Basin and its utilization," has been prepared by Ralf R. Woolley, hydraulic engineer of the Geological Survey, and the late C. C. Jacob, for several years water master in the Uinta Basin.

This report considers the present utilization of the water supply of the basin for both irrigation and power and proposes plans for the future utilization for both purposes.

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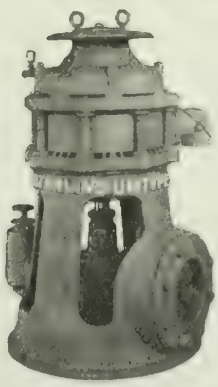

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AMONG OUR CONTRIBUTORS

Some Editorial Jottings About Current and Forthcoming Feature Articles Dealing With Practical Problems of Irrigation, and the Men Who Have Written Them

AS ASSOCIATE irrigation engineer, in charge of the Los Angeles office of the Division of Agricultural Engineering, U. S. Department of Agriculture, Harry F. Blaney is well qualified to write on the cost of water to farmers under California irrigation enterprises. Mr. Blaney has been identified with this branch of the government, which is devoted to irrigation research and investigations, since 1917.

During this time most of his work has been done in co-operation with the State of California, with the exception of one year, spent in Utah and Colorado. He is the author of Bulletin No 8, recently issued by the California Department of Public Works, Division of Engineering and Irrigation, under the title, "Cost of Water to Irrigators in California," and his article in this issue, written especially for MODERN IRRIGATION, is based upon the investigations of which this bulletin was a summary.

Mr. Blaney was born in Los Angeles in 1892, and was graduated in Civil and Irrigation Engineeering in 1915 from the University of California. He is an associate member of the American Society of Civil Engineers.

ON THIS page last month it was promised that C. A. Utley's discussion of the facilities for display afforded irrigation equipment manufacturers at the California State Fair would be an intriguing story—and it is. Mr. Utley is field engineer for the Pelton Water Wheel Company, having held this position for the past eight years; and is Secretary of the Western Irrigation Equipment Association. His interest in obtaining a better display of irrigation equipment is, of course, primarily taken from the standpoint of the manufacturer; but in his story of John Baxter's search for the "Machinery Building," he was wisely treated the problem from the standpoint of the potential buyer, who goes to the fair, not for its horse-racing or catch-penny amusements, but for the practical purpose of seeing an exposition of the most advanced equipment.

Mr. Utley is a certified member of the American Association of Engineers, and a member of the California Committee on the Relation of Electricity to Agriculture.

FRANCIS CUTTLE, who writes for MODERN IRRIGATION on the meaning of conservation, is a pioneer conservationist of the west. Since 1909 he has been president of the Water Conservation Association of Southern California; and since 1907 has been chairman of the Tri-Counties Reforestation Committee. He was instrumental in forming both of these organizations, and has served as their executive head as long as they have been in existence. He was for five years a member of the California Conservation Commission, and is now a member of the State Board of Forestry of that State.

He is a member of the Board of Editorial Advisors of MODERN IRRIGATION, and in the July number of the magazine was introduced to our readers in more detail.

THE SECOND instalment of B. J. Seger's article on "Adequate Farm Loans for Irrigated Lands" appears in our department devoted to Irrigation Finance. Mr. Seger has lived through the problems with which he deals in this article. In addition to his work in constant touch with the financial affairs of the North Platte Valley Water Users' Association and the Farmers' Irrigation District, of which he is Secretary and Treasurer, he has a broad acquaintance with the financial problems of irrigation projects throughout Nebraska and other parts of the country. As a member of the legislative committee of the State Irrigation Association he has assisted in securing the enactment of laws which make possible such solutions of these problems as he advises in this article.

BRAINERD B. SMITH, author of the article on Page 14, in which he tells of plans to reclaim desert lands by pump irrigation under government supervision, is the officer in charge of the United States Land Office at Los Angeles.

Prior to July 1, 1925, Mr. Smith was Register of the Land Office, but a reorganization of the California offices as of that date has consolidated the Los Angeles and El Centro branches and combined the duties of the Receiver and Register under one head.

Mr. Smith is another "native son" of California, and has made his home in Pasadena for the past twenty years. For more than twenty years he has been an engineer, following Mining and Civil Engineering as a profession. He was appointed to his present post by former President Harding, and reappointed by President Coolidge.

ARNOLD P. YERKES, author of our article on the use of tractors on irrigated farms, is connected with the International Harvester Company, Chicago, and has his headquarters in that city. He is editor of "Tractor Farming," a publication put out by his company, and is known as a specialist on farm implements. A paper read by Mr. Yerkes on a phase of this subject was a feature of the recent national convention of the American Society of Agricultural Engineers.

PROFESSOR BECKETT, whose paper, entitled "Some Agricultural Engineering Problems of Irrigated Agriculture," delivered at the recent convention of the American Society of Agricultural Engineers, is published in this issue, is a native Californian and a graduate of the University of California with a B. S. degree from the College of Civil Engineering. He began his career, as so many men who have become well known in the irrigation world have begun theirs, with the U. S. Reclamation Service, as a transit-man and assistant engineer. From 1909 to 1912 he was identified with the Department of Agriculture, and in the latter year became connected with the University of California where he is now Associate Professor of Irrigation Investigations and Practice.

DAVID WEEKS, author of the "lead feature" of the Reclamation Department, is engaged in agricultural economic research for the Department of Agriculture, University of California, and is also Consulting Engineer for the United States Bureau of Reclamation. Prof. Weeks is chairman of the committee appointed by the Department of the Interior to investigate the economic feasibility of the Spanish Springs Reclamation Project, Nevada, which came into the limelight in the last session of Congress. He was formerly in charge of Drainage and Irrigation instruction at Iowa State College, and has been engaged in general Consulting Engineering practice. On different occassions Prof. Weeks has served as Vice-President on the National Council of the American Society of Agricultural Engineers. He organized the Reclamation Division of the American Society of Agrictural Engineers and served as its first chairman. His article on the application of economic principles to the National Reclamation pclicy is a part of a paper recently presented before the Pacific Coast section of the A. S. A E.

DURING the next few months MODERN IRRIGATION will contain many valuable technical contributions from outstanding experts in western irrigation. One of the men who is preparing a helpful feature to appear in our columns, in an early issue, is A. M. Barton, chief engineer of the State Reclamation Board of California. Another well-known contributor who has promised to have a feature for the magazine very soon is D. W. Murphy. Mr. Murphy's special activity has been in the reclamation of irrigated lands that have "gone alkali." He has been in charge of this work for the Imperial Irrigation District in a consulting capacity and has directed the reclamation of a very large acreage of alkaline and water-logged lands.

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For 12 Months: $2.00; Single Copies: 20 cents.

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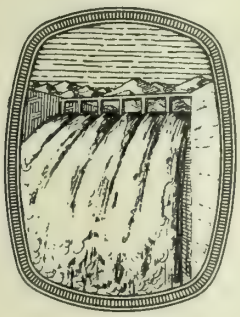
GEORGE W. P. HUNT

Governor of the State of Arizona, and storm center around whom the controversy over Arizona's attitude toward the "Colorado River Compact" rages with redoubled fury as the result of the abortive conference of the California, Arizona and Nevada delegates during August. Governor Hunt began his Arizona career as a ranchman on the Salt River, from 1881 to 1891, and has been a figure in the political life of the state since 1893. Two articles in this issue are devoted to the Phoenix conference.

MODERN Irrigation
The Magazine of Applied Hydraulics



Volume 1 SEPTEMBER, 1925 Number 3

The Progress *of* Irrigation

ARIZONA'S governor, Hon. George W. P. Hunt, addressing delegates from Nevada and California and his own committee, representing Arizona, who had gathered at Phoenix on August 17th to discuss the problems of the development of the Colorado River, set forth the theory that the river is a resource of the people of Arizona, and that her sister states who may be desirous of the immediate development of that resource ought, in fairness, to make satisfactory offers of compensation.

Arizona, declared Governor Hunt, in effect, is not seeking any development of the Colorado at this time; her attitude is passive; and her only concern is to see that her rights are protected against encroachment.

The storm which this pronouncement precipitated, in the midst of which the conference adjourned abruptly and without the slightest accomplishment, centers around the stalwart head of the governor. Unfortunately there has been, in the first reaction to his remarks, too much of a matter of personalities involved to reflect much light upon the major issues involved.

GOVERNOR Hunt is supported by a strong faction who see in him the hope of protecting the greatest resource of a state to which Nature has been, in truth, not too generous. But his attitude does not reflect the unanimous sentiment of Arizona; he is opposed by many who accuse him of supporting a vacillating policy dictated by political expediency and selfish interests. And from outside of his own state still more recrimination is heaped upon him by those who see, in his insistence that Arizona is satisfied with the *status quo* on the Colorado, a manifestation of the attitude which made famous the dog in the manger.

The Colorado River is bigger than any individual, and it ought not to be discussed on the basis of personalities. Whether Governor Hunt's remarks at the Tri-State Conference were the expression of his own deep and conscientious conviction—as must be assumed—or whether they may have been in part inspired by a desire to further his political fortunes in Arizona, as some have declared, there is no doubt about the philosophy which he expressed. As plainly as words could say it, he declared that the Colorado River is a possession which

Arizona is not disposed to share without a sufficient *quid pro quo*. If that philosophy is an unreasonable one, it must be shown to be such.

The people of Arizona, or any large percentage of them, are not to be blamed if they are reluctant to hand over the water resources which are so important to the state's development. The whole matter of the Colorado River, however, is so complexly affected by engineering, financial and—above all—by political factors, and there is so little agreement on any one of these phases of the main issue, that it is no wonder the lay observer is bewildered and unwilling to accept any man's word as final. In such a situation the political philosophy of Governor Hunt might, indeed, have been shrewdly calculated to appeal to the average citizen. Not able to judge for himself of engineering feasibility, nor to identify clearly the political interests involved, he is more willing to let matters rest as they are than to commit himself to any definite course of development.

NEVERTHELESS, the welfare of the Southwest as a whole is demanding the development of the Colorado. Those who champion such development believe that the interests of Arizona are closely and vitally identified with those of her sister states in requiring its development at the earliest possible date. It is for them to demonstrate this to the legislature and the people of Arizona. Governor Hunt is not an hereditary monarch. If his policies are proved to be wrong, to the satisfaction of the people of Arizona, he will very soon be removed from the scheme of things. Until the people of Arizona are convinced that their *own interest* lies in sharing the Colorado River with California and Nevada, as well as with the upper basin states, they are doing only the natural thing to insist upon making haste slowly.

ANOTHER focus of controversy now attracting attention, into which it is difficult for outsiders to see clearly, is the Imperial Irrigation District in California, which is suffering the pains of reorganization, complicated by a light and heavy artillery fire upon the directors of the district, by those who believe that they have gone beyond their rightful powers in their desire to aid the Swing-Johnson bill.

In response to an invitation from MODERN IRRIGATION, the president of the Imperial Irrigation District tells, in this issue, what the directors of the district are attempting to accomplish. Mr. Pound's explanation of the directors' policy of reorganization gives an illuminating glimpse of some of the vicissitudes faced by irrigation administrators.

IN THE "unfavorable" report submitted to Secretary Work by the special commission which investigated the Columbia River Basin irrigation project, there is something of encouragement for those who are banking on the great future of the West. The report finds that the project is technically feasible; but it advises against the Bureau of Reclamation assuming responsibility for it, on the ground that the proper time has not yet come, and the experience of the Bureau has not been sufficient to justify the assumption of so complex and immense a task.

Thus, even while those who are most anxious for the project's development are temporarily discouraged, they are, at the same time, vindicated in their beliefs. The Columbia River Basin project is pronounced feasible. It is a matter of time only until their prophetic visions of its transforming potentialities will be demonstrated.

TEXAS, Oklahoma and New Mexico have large plans on foot for developments which will serve the three related purposes of flood control, power generation and reclamation by irrigation. Irrigation commissioners from these three states, and many interested engineers, were in conference in August at Amarillo, Texas, and later at Tucumcari, New Mexico.

A dam to be erected on the Canadian River near Logan, New Mexico, forms the principal link in the chain of projects which this conference has envisioned for development in these states. In magnitude the dam, as contemplated, would represent the largest irrigation project in the world. It would form a water storage reservoir sufficient to irrigate from three to four million acres of arid land in two states.

These plans are not mere creations of the too hopeful imagination. Surveys of the North and South Canadian Rivers, the Cimarron River and the Red River have been made under authorization of Congress, which appropriated $1,500,000 for the purpose. The projects under consideration are too big to be worked out in a short time—enterprises of such magnitude require years—but they, or other similar developments, will eventually come to pass. Every state in the West, from Texas to Washington, faces activity in irrigation within the next twenty years beside which the past two decades may scarcely be compared.

Arizona is Center of Great Construction Activity

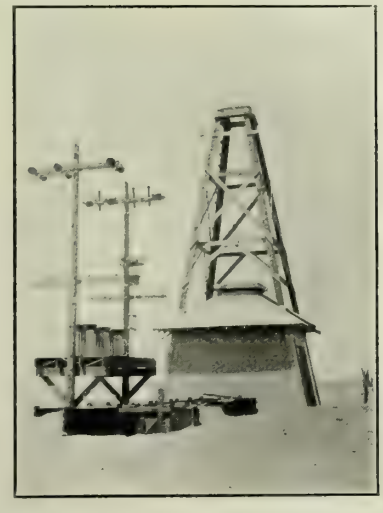
Roosevelt Conservation District's Developments Described in Detail

Grader on the Main Canal of the Roosevelt Water Conservation District's 41,500-Acre Project

By H. I. WOOD
Construction Engineer

THE ROOSEVELT Water Conservation District of Arizona recently completed the construction of the major portion of its 41,500-acre project adjacent to and east of the Salt River project.

One of the most successful irrigation projects in the west is the Salt River Valley project, receiving its water from the great Roosevelt Reservoir on the Salt River in Arizona. About 240,000 acres are irrigated under the project and the prosperity of this section of Arizona is well recognized. The Roosevelt Water Conservation District is another one of the projects in the same valley which is being put under irrigation with its main source of water supply from the Roosevelt Reservoir.



TYPICAL OF THE STRUCTURES SERVING ROOSEVELT PROJECT

The Roosevelt Water Conservation District, with headquarters at Mesa, Arizona, contains 41,500 acres, is curved in form toward the eastern side and parallel to the rising rim of the Salt River Valley. It is about 18 miles in length and about 3.5 miles in width. The eastern boundary of the District is formed by the main canal of the project and the western boundary by the eastern canals of the Salt River Valley project.

IT SELDOM occurs that the interests of two irrigation projects are so mutually and advantageously related as are those of the Salt River project and the Roosevelt Water Conservation District. More than half of the District's water supply will be obtained by lining of 34 miles of the canals of the Salt River Valley Water Users' Association, the operating organization of the Salt River project. The cost will be paid by the District. This conserved water, in some sections to be lined, is as much as ten per cent of the flow. A contract between the Association and the District stipulates the amounts of conserved water in percentages of the flow in the lined canals and carries also the right of regulation in the Roosevelt Reservoir when space is available.

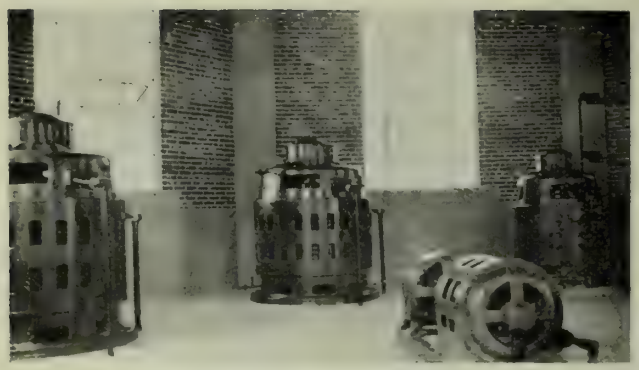
The water conserved by canal lining, amounting normally to about 60 per cent of the requirements of the District, and the flood water of the Verde River, are diverted at the Granite Reef Dam on the Salt River, about six miles east of the District's main pumping plant. The balance of the water is obtained by pumping from wells in the southern end of the District. The water requirements have been based upon an average application at the fields of 3.2 feet of water per annum on 90 per cent of the total area of the District. The average transit losses are taken at 10 per cent because the main canal will ultimately be lined and the laterals are relatively short; averaging somewhat less than three miles.

The main pumping plant has a capacity, in the four units now installed, of 200 second feet and lifts the water 52 feet into the head of the main canal. It has two 30-inch and two 20-inch wet pit type Byron-Jackson vertical, centrifugal pumps driven by two 600 H. P. and two 200 H. P. vertical, synchronous, General Electric motors. The four units as now installed discharge through one 66-inch diameter concrete pipe line. Provision has been made in the building and arrangement of the plant for the additional installation of two 30-inch pumps and two 600 H. P. motors. When these are installed and a second 66-inch pipe is built, the capacity of the plant will be 350 second-feet. The discharge of the pumps is controlled by hydraulically operated gate valves which are closed automatically by magnet operated valves in case of failure of power. An automatic Kewanee pressure system with a pressure tank supplies the pressure for operating the hydraulic valves.

The discharge pipe line is equipped with a Builders Iron Foundry Company's venturi meter and recorder. The building is octagonal in plan, and of reinforced concrete. The sump below the motor floor, in which the pumps are located, is divided into two compartments by a center division wall. This wall supports the floor beams at the center line of the building. A trash rack made up in removable panels and supported vertically in vertical I-beams is set radially around the front of the building. By removing the trash rack panels and substituting flashboards in the grooves, either half of the sump can be isolated from the forebay and unwatered, permitting inspection or repairs of the pumps or valves. The forebay is designed with considerable width and the velocity of approach will be lower than the flow of the Association's canal, from which the water is diverted and it is anticipated that very little trash will reach the plant.

WALLS of the motor room have brick panels, steel sash and ribbed glass windows. The roof is supported by heavy steel trusses and covered with Mission tiles. An outdoor type substation, consisting of four 833 KVA Westinghouse transformers with lightning arresters and oil circuit breaker, has been constructed adjacent to the pumping plant to transform the incoming electric energy from 44,000 volts to 2,200 volts. The pumping plant and substation cost $103,000.

The main canal along the eastern boundary of the project is 21 miles long



Interior View of the Main Pumping Plant, Which Has Two 30-inch and Two 20-inch Wet Pit Type Byron-Jackson Vertical Centrifugal Pumps

and has a maximum bottom width at the upper end of 16 feet and side slopes of 1 on 1. It has a capacity, unlined, of 200 second feet, which is just equal to the capacity of the pumping plant as now completed. The capacity when lined will be 350 second feet. The main canal crosses under the Apache Trail Highway through a reinforced concrete box type culvert. A similar type crossing was constructed under the Arizona Eastern Railroad. There are 14 county road timber bridges with concrete abutments across the main canal. Fourteen reinforced concrete checks are also provided on the main canal. The checks have hand wheel operated, steel gates. They vary in size according to the canal capacity, the larger checks having four 48x48-inch gates and the smaller having two gates 30x42-inch. Thirty-five delivery gates from the main canal were provided, consisting of 24-inch or 30-inch diameter concrete precast pipe 20 feet in length provided with concrete headwalls and wings and Calco Model No. 101 gates.

EXCAVATION on the main canal was done mainly with a New Era elevating grader operated by a Best tractor. Two P. & H. three-quarter yard draglines were used, one on the first 3,100 feet of the canal where hard caliche was encountered and the other at the lower and smaller sections of the canal. A total of 201,000 cubic yards was excavated on the main canal in five months. The same two draglines also excavated 97 miles of laterals.

The laterals in general follow the section lines with deliveries to the high point of each quarter section of land. The laterals were constructed with 1 to 1 side slopes and 3-foot bottom and averaged about .4 cubic yards per foot. Seventeen miles were built with stock and 97 miles with the two drag lines which also worked on the main canal. The lateral work, including 3.5 miles of 8-foot bottom and 2 miles of 6-foot bottom main lateral, forming the Eastern canal extension, involved, in all, 227,000 cubic yards.

The lateral structures included six timber bridges, four concrete checks, two timber flumes, two 18-inch concrete siphons, nine cast iron delivery gates with concrete pipe and wings, similar to those on the main canal, 204 redwood turnouts, 60 redwood drops, eighty-six corrugated Amsco pipe culverts 24 inches by 20 feet, and twenty-eight corrugated Amsco pipe culverts 30 inches by 20 feet, for county road crossings.

TWELVE old wells were taken over and twelve new 20-inch wells were drilled to an average depth of 308 feet. These twenty-four wells have been equipped with Byron-Jackson deep well pumps. Most of the old wells had 16-inch casings and in these were installed No. 3 screw pumps with 10-inch diameter columns. The other wells were equipped with No. 6 turbines with 12-inch columns. The average designed lift is 91 feet. The discharge will average about 75 second feet from all the wells. The lower lift pumps have 60 H. P. motors and the others have 75 H. P. motors. The pump heads are the Byron-Jackson built-in type which are all the same size and have the thrust bearing on top of the motor. The motor part is 440-volt General Electric Company's make.

The principal advantages of this type head are its rigid construction which makes it free from vibration and the ease of making adjustment of the impeller clearances. The motors are equipped with 440-volt 75-H. P. automatic starting compensators and time delay relays set for sequence starting. A switchboard in each plant mounts the ammeter, watthour meter, manual control switch, ammeter shunt switch and the time delay relay. The power is distributed at 11,000 volts and is transformed at each well by an outdoor pole type sub-station, equipped with Kellman oil circuit breaker, choke coils, lightning arrestors and three 25 KVA Westinghouse oil immersed transformers. The pump equipment is housed in a wooden building built at the base of the towers.

THIRTY miles of 11,000 volt transmission line was constructed to serve the wells. An outdoor type sub-station was constructed near Chandler consisting of four 833 KVA., 44,000—11,000 volt Westinghouse transformers and lightning arresters and General Electric Company oil circuit breaker. Eight miles of this line was constructed jointly with the Queen Creek Irrigation District, i. e., two separate power lines were erected on one set of poles.

The lining with concrete or asphalt or both, of the Association's canals will be undertaken during October, November and December of this year when the flow in the canals can be interrupted. This work involves the lining of 34 miles of the Salt River Valley Water Users' Association's canals, beginning at Granite Reef Dam. The expense of this lining will be paid to the Association by the District and involves about eight million square feet which has been estimated at $835,000.00.

The lining of the District's own main canal will be done under the second period of construction and only after more than 60 per cent of the land is under irrigation. This will require about three million square feet of lining. This work and the addition of two 30-inch pumps and motors and the second pipe line at the main pumping plant will complete the District's project.

The advantage of keeping the investment in construction as nearly as possible parallel with the development of the project has still further been carried out in a power contract between the Association and the District. The contract provides that the District may purchase power at actual production cost

(Continued on Page 32)

Elevating Grader on the Main Canal. Excavation on This Canal Was Done Mainly with a New Era Elevating Grader Operated by a Best Tractor

The Mighty Colorado—a Dry Bed—after the Imperial Irrigation District is Done With It. This View Shows the River just Below the District's Intake at Andrade, When Every Drop of Water in the River was being Diverted

What the Board of Directors of the Imperial Irrigation District is Trying to Do

By EARL C. POUND

President, Imperial Irrigation District

ANY DISCUSSION of the reorganization program now being pursued by the Board of Directors of the Imperial District must of necessity include a brief statement of the conditions existing in the district.

It is doubtful if there is any irrigation district in the United States that has occupied the attention of the public eye as long or as consistently as has the Imperial Irrigation District. Almost every action taken by this Board has had an attendant flood of approval or criticism, not only from those who live in the Imperial Valley, but from Los Angeles, Sacramento, and even from the government departments in Washington, D. C.

For that reason, the Board of Directors is constrained to move slowly and only after careful deliberation, even in matters that would ordinarily attract no particular comment.

WITH this general situation in mind, it is possible to go into the detail of the economy program now in process of being worked out by the Board. The program is not in itself unusual, nor is it one that calls for the exercise of extraordinary powers in a District Board. Probably in no other irrigation district in California would such a move attract outside attention. It is true that the elimination of certain department heads has been necessary and that combination of certain offices, requiring dismissal of the men in charge, has been effected. But that phase of the program is purely incidental and in no way to be considered significant of schemes having an ulterior motive. The whole thing is simply a matter (one of many) of routine in the duties that fall to the Board of Directors of any irrigation district.

AS A MATTER of fact, what is actually taking place under the action of the Directors is a cutting away of every unnecessary item of expense in the operation of the irrigation system, a centralization of responsibility and a corresponding increase in efficiency.

To effect such saving to the people, the Directors have taken inventory of the District. They have found that the office of Chief Engineer is one that is essentially obsolete from point of need in the maintenance of the District. There are no large engineering works to be built at present. Rather than an engineer, it is found that the system requires an executive to superintend and be responsible for efficient maintenance of the system that has been built. Therefore the Board has dispensed with its Chief Engineer and in his place hired a general superintendent. That the general superintendent must be an engineer as well as a business executive is accepted, and the position has been filled with that qualification in mind.

The inventory revealed the fact that the District shops were not being operated so as to give the maximum service to the system. It was accordingly the duty of the Board to make them more efficient. In doing that it was seen that removal of them and the general offices from Calexico, on the extreme south border of the District, to Imperial, in the center of the District, would save hundreds of thousand of dollars to the people. The move was accordingly ordered by the Board, and that it was justifiable is shown by savings already actually made. Certain interests saw fit to attribute political significance to the removal procedures, but their injunctions were denied by the court and the action of the Board approved in a clear-cut decision handed down by a judge brought in from the northern part of California to hear the case.

A PARAGRAPH from the report of the master-mechanic in charge of the new shops at Imperial will indicate some of the results of the action by the Board:

"On April 1, 1925, when I assumed charge of the Imperial shops, I was assured by the shop foreman that accumulated unfinished work would require at least three months to complete even if no additional work came in. There were 69 men on the payroll then. It is my pleasure to report that within one month all accumulated work was finished

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GLENN D. SMITH

GEORGE L. SWENDSEN

WILLIAM DURBROW

Comprising the Present Membership of the "Irrigationist" Group of MODERN IRRIGATION'S *Board of Editorial Advisors*

Three Prominent *"Irrigationists"* Are Counsellors to *Modern Irrigation*

WEBSTER defines an irrigationist as "one who is interested in, or who carries on, or favors, irrigation," while an irrigator is, of course, "one who irrigates."

This distinction is the fundamental one recognized by MODERN IRRIGATION in the creation of a group of members on its Board of Editorial Advisors representing "irrigationists," but there is something more implicit in the word than suggested in the dictionary definition.

The farmer who supplements rainfall artificially is an irrigator, no matter how small or how large his activities, as such; but to be an irrigationist his interest in irrigation must extend beyond the confines of his own acres, his own furrows and standpipes, and he must envision irrigation as a broader, bigger thing than an incident to his own livelihood.

Those men are irrigationists, in the larger sense, whose skill and activity are dedicated to the promotion of sound irrigating methods, embracing a knowledge of the problems of water from the time it is precipitated from the clouds to its transpiration back into the air.

The president of the California Mutual Water Companies Association; the president of the Irrigation Districts Association of California, and an active managerial and engineering executive, recognized as one of the leaders of the western industry, are the three men selected from California as representative of irrigationists, who comprise this group of MODERN IRRIGATION'S Board of Editorial Advisors.

WILLIAM DURBROW, president of the Irrigation Districts Association of California, was graduated from the University of California in Engineering, with the class of 1899. After spending a few years in mining and smelting work, including an extensive trip to the West Coast of South America, in 1903, he became engineer and manager of water and power properties in Butte County, California, which later became known as the Oro Electric Corporation.

About this time, Mr. Durbrow became interested as a land owner on the West Side of the Sacramento Valley where his interests have mainly been ever since.

During the World War he served his community as Food Administrator of Glenn County.

In 1919 he became one of the leading organizers of the Glenn-Colusa Irrigation District, the largest irrigation district in the northern part of California. After the organization of this district Mr. Durbrow became president of the district and remained so until he resigned to become the secretary and manager of the same district.

In 1923 he was chosen president of the Irrigation Districts Association of California, and was re-elected to this office in 1925.

In 1924 he was appointed a member of the Permanent Committee of the Sacramento-San Joaquin River Problems Conference, and has taken a prominent part in the working out of the water difficulties along the Sacramento River.

In 1925 Mr. Durbrow was elected Trustee and President of Reclamation District 2047, a district containing a quarter of a million acres, organized for the draining of the West Side lands of the Sacramento Valley.

By virtue of his prominence in irrigation affairs he has repeatedly served on various committees having to do with the development of the water resources of the West.

GLENN D. SMITH, president of the California Mutual Water Companies' Association, is vice president and general manager of the San Antonio Water Company and of the Ontario Power Company, of Ontario, California. Mr. Smith came to the west from Michigan in 1907, leaving an executive

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GOVERNMENT ENGINEERS TAKING SOUNDINGS AT THE BOULDER CANYON DAM SITE. THIS IS THE SITE THAT NEVADA FAVORS AND GOVERNOR HUNT OPPOSES

Tri-State River Conference Adjourns in Disagreement

Governor Hunt's Statement Made Discussion Futile, Visiting Delegations Declared

L'ETAT C'EST MOI, (*I am the State*) declared Louis XIV of France. Something of the same imperial attitude is read by many observers into the statement of Governor Hunt of Arizona before the Tri-State Conference on the Colorado River, the reception of which led to the adjournment of that body without accomplishment.

Friendly partisans, on the other hand, see in Governor Hunt's speech, in which he stated his position and impliedly the position of the delegation representing Arizona, merely a laudable determination to protect the political and economic rights of the state against would-be encroachers.

Convening in the senate house at the Arizona capital—Phoenix—on August 17, the conference had time only to receive Governor Hunt's message, to deliberate briefly upon its implications, and to declare that it precipitated a situation which made futher conference impossible, before adjourning *sine die* at 3:45 in the afternoon.

HARDLY had the vote of adjournment been taken, however, when negotiations for a second conference were under way, and plans laid for a new meeting at which a legislative committee, appointed by and responsible to the legislature of Arizona and not to its governor, would represent that state in the discussion with the Nevada and California delegations, who are reported to be willing to make another attempt to establish a common ground of agreement among the three states.

Governor Hunt's statement, which displeased the visiting delegations and led to the premature adjournment of the conference, was an address of several thousand words, personally presented by the executive as the first order of business after the meeting was convened.

"Gentlemen," he began, "you meet here today in conference in an endeavor to find a remedy for, and to reconcile some of the defects contained in, the Colorado River compact, which was negotiated at Santa Fe, N. M. This compact purports to allocate the waters of the Colorado River in accordance with the terms of a uniform law passed by Congress and the seven states in the Colorado River basin."

Then follows a criticism of the compact which points out four "fundamental errors"; the first of which, as claimed by the speaker, is that the allocation of water is made on a basis of upper and lower basins rather than "between the states" as authorized by the law; second, that too much water has been apportioned to the upper basin and too little to the lower; third, that no provision is made to prevent water stored in the United States from being applied to Mexican lands; fourth, that while upper basin states would be served from the natural flow of the river, the lower basin would have to depend on storage entirely, and that no allowance is made for loss by evaporation from stored water.

"Why," asked Governor Hunt, "should any compact be negotiated which sets aside the present well-established and defined water laws?" And he answers his own query by pointing out, as a reason: "the far-sighted business acumen of some of the states in the basin who are endeavoring to secure, for use in the distant future, rights which they do not possess under the law."

"The upper basin states are demanding all they can get for themselves," he declared, with vigor. "Why should we not do likewise?"

ANSWERING his own question "What does Arizona want from the Colorado River?" the speaker candidly declared that he did not know.

"At this time all we ask for, if the economic laws are to be set aside and a treaty negotiated, is that Arizona receive protection of her rights including her future development. If you ask me specifically what we want I reply to you frankly, without any apology, that we do not know because we have not sufficient data available to determine what it is practicable to develop.

"Arizona is in the position, if the present water laws remain undisturbed and unimpaired, of asking nothing. We are fully satisfied with the present laws as interpreted by the United States Supeme Court. We are fully able, under present laws, to protect our interests from all of the other six states in the basin and from Mexico. We do not fear development in Califonia or in the upper basin if the law of priorities, based upon appropriation for beneficial use, remains in full effect. But if that law is to be disturbed, modified or set aside, we have immediate cause for alarm."

It was apparently this attitude of being satisfied with the status quo that convinced the visiting delegations of the hopelessness of further discussion. Governor Hunt's whole thesis was that "economic law and self-preservation dic-

tate our policy in this matter," and that if Arizona has something which her sister states want, it is for them to make a proposition that suits Arizona.

"If Arizona signed the Colorado River compact in its present form we would be signing away our future right to utilize the resources of the river without recompense. If we have something you want and can utilize, economic justice dictates that it be paid for."

The statement concluded: "At this time Arizona is asked to negotiate and distribute resources from the biggest asset she has because some other sections of the country assert that the immediate development of this asset is imperative to their welfare. We are unprepared to negotiate but if an adjudication can be worked out that sounds anywhere near fair and equitable to this state, I shall be very glad of the same. I stand ready to co-operate with you and to make available any information we possess. I trust that your labors may prove successful."

WHILE the California and Nevada delegations persisted in regarding this statement as an "ultimatum" which must necessarily bind the Arizona committee and thus make further conference useless, the Arizona representatives contended that they were not necessarily bound by the governor's statement and attitude, and for their own part, asserted that the Nevada delegation had come with preconceived ideas that made the effort to reach a common agreement a vain hope.

The Arizona committee, whose official personnel was comprised by Cleve Van Dyke, Miami; Thomas Maddock, F. A. Reid, and H. S. McCluskey, of Phoenix; and A. T. McGregor, of Warren; issued a statement after the close of the conference which placed the onus of its failure on the Nevada and California committees. The statement declared:

"The committee appointed by Governor George W. P. Hunt, to confer with the committees representing the States of California and Nevada, were left by the Governor absolutely free to act, without any instructions as to any particular reservations that Arizona should ask for in connection with any development undertaken on the Colorado River.

"The Arizona Committee stated openly that they were in no wise bound or limited in their discussion except by their conscience and their duty to their state; that any conclusions or agreements that might be reached would be tentative in form and would have to meet and stand the test of the criticisms of the legislatures of the three states and of Congress and possibly of the other states in the basin and would have been subject to possible modifications and amendments.

"The California and Nevada committees advanced an arbitrary and impossible promise as a basis upon which negotiations or even discussions by the joint committees could proceed. Their ultimatum, as a prelude to any negotiations, or even discussion, provided that Arizona must unreservedly agree that the first construction of dams on the Colorado River should be at Boulder Canyon or its vicinity. They would not even agree to a discussion concerning the allocation and distribution of the water and power made available by the Boulder Canyon Dam until Arizona had agreed to the principle that the initial development should be at that location. This in effect means that it was demanded of Arizona that she sign a contract in blank on the dotted line, the terms and conditions of which would later be inserted in the document.

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Oregon Irrigation Congress To Discuss Vital Problems

GRANTS PASS, Oregon, will be the scene of an irrigation gathering of more than ordinary interest on October 5, 6 and 7, when the Oregon Irrigation Congress will be in session there. A program of practical value, dealing with the pressing water problems of the northwest, has been arranged by the officials of the Congress, and those present at the meeting will include many of the outstanding irrigation figures of the nation.

James M. Kyle, president of the Oregon Irrigation Congress, has given out the following statement for publication in MODERN IRRIGATION:

"THE NEXT annual meeting of the Oregon Irrigation Congress will be held at Grant's Pass, Oregon, on October 5th, 6th and 7th. It is expected that this gathering will bring out a large attendance, as some very important matters will come before the Congress—such as the problem of state co-operation with the federal Bureau of Reclamation, in reference to aided and directed settlement on federal projects. The matter of refinancing state projects which now need help will also come before the meeting.

"Personally, I do not believe in state aid for Government projects," writes Mr. Kyle, "for if state aid is to be demanded as a condition precedent to the government undertaking the development of any irrigation project, the requirements thereof should be designated in a bill of general application. It should become a general policy of the government rather than a policy to be applied to one project and withheld from another, and there should be uniformity running through the whole plan or program. Changing our whole policy of reclamation by an appropriation bill so worded as to affect one distinct project is an absurdity.

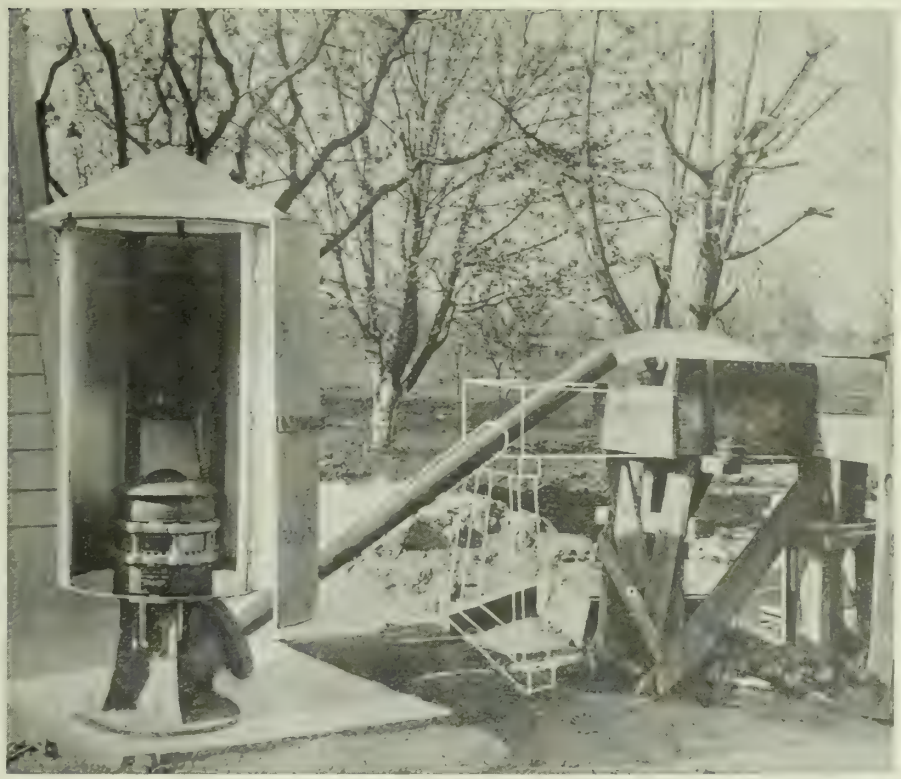
"It is not the proper field for state activity; it is not proper that a state should be called upon to aid the federal government in this work. The money used in reclamation does not come from the general treasury of the United States; it is created by the states themselves wherein these projects are located, and the theory of the law, and the reason therefor, was to make government lands inviting to private ownership."

AS FORESHADOWED by Mr. Kyle's statement, state and federal reclamation policies, in which Oregon is vitally interested, will have the spotlight of attention during part of the Congress. Senator McNary and Senator Stanfield, Oregon's representatives in the upper house of the national congress, will be there, Senator McNary's voice having added influence on account of his position as chairman of the senate committee on irrigation and reclamation.

W. L. Boise, chairman of the Land Settlement Committee of the Portland, Oregon, Chamber of Commerce; Roderick Maclay, President of the Portland Chamber of Commerce; and Marshal Dana, of the Oregon *Journal* are expected to be present to participate in the discussion. Elwood Mead, Commissioner of Reclamation, will either attend the meeting or be represented officially.

I. L. Patterson, of Salem, Oregon, will discuss "Irrigation in the Willamette Valley," and Franklin T. Griffith, President of the Portland Railway Light and Power Company, will speak on "State Development."

A distinguished guest of the Congress will be Governor Walter M. Pierce, who is actively concerned in irrigation both by inclination and by virtue of his official duties as chief executive of the state. Governor Pierce will deliver an address on "Agriculture in Oregon."



SIMPLE CHANGES LIKE THOSE HERE INDICATED MAY EFFECT A CONSIDERABLE SAVING IN THE ANNUAL POWER BILL

The Irrigation Engineer Must Figure Every Penny

By JOHN R. JAHN

Irrigation Engineer

THE FEASIBILITY of an irrigation plan is often dependent upon the probability of there being an adequate return on the necessary capital outlay. Careful consideration of the major economic problems involved is customary in the design of all large projects. There are so many examples of uneconomic design in the smaller units of equipment, however, notably in connection with pumps, piping, and field ditches, that the minute consideration of these features needs to be emphasized. Care in these designs will result in larger profits to the farmer, who depends on the yearly excess of income over outgo.

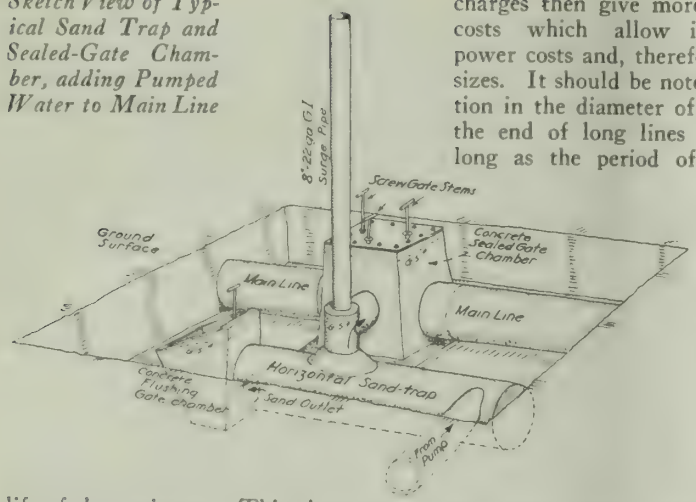
Among all of the applied sciences, probably none allow of such critical analysis, from an economic standpoint, as does irrigation hydraulics. Here we have certain work to be performed by the expenditure of funds for the installation and maintenance of equipment. The "best" selection is the one which satisfactorily performs the service for the least ultimate cost. The considerations in this ultimate cost involve (a) first cost and (b) annual expenses. Selection also considers (c) adaptability and (d) dependability, the money value of which are matters of judgment.

The first cost is often given undue importance, allowing the future to care for the others. In this way second hand pumps of incorrect size, pipe conduits too small in size, and small wells, are often installed because of lower first cost. The consequent annual charges may then be out of all proportion to the first cost. The writer recently had occasion to check up the discharge piping from a 36-inch centrifugal pump which was designed to deliver 67 second feet through a 42-inch riveted steel pipe having a length of but 150 feet. It was found on analysis that the annual cost of power for overcoming friction in this line, if capitalized at 6 per cent, would pay for a parallel line of 42-inch pipe and in addition have the interest on $3,000. While the first cost of the single line seemed high, it is apparent that double the expenditure was justified.

TABLE OF FRICTION FACTORS FOR VARIOUS KINDS OF PIPE

Kind of Pipe		Range Gal. p. min.	Range Cu. ft. p. sec.	Friction Factor ft. p. ft.
Wood Stave Pipe	from	500	1.1	.002
	to	9,000	20.0	.0005
Concrete Pipe	from	300	.67	.003
	to	4,500	10.0	.0008
Low Pressure Riveted Steel and Galv. Iron Slip Joint Pipe	from	100	.22	.004
		700	1.55	.0015
	to	40,000	60.0	.00065
Wrought Iron (Screw joints)	from	5		.015
	to	500	1.1	.007

THERE are two methods of economic analysis, both of which compare expenditures in the attempt to obtain the lowest ultimate cost. They give, however, different results. One method, the usual one, capitalizes annual charges at current rates of interest and adds that to the first cost, the selection showing the lowest combined cost being indicated. The second method amortizes the first cost to spread it over the probable life of the equipment, adding thereto the annual charges. The selection showing the lowest total annual charge is then indicated. The second method is preferable to the first in that its selections have smaller size and consequently lower first cost. This is due to the fact that while the first method capitalizes the annual charges at the current rate of interest, the amortized charge is based on the interest rate plus a rate which will write off the capital during the estimated



Sketch View of Typical Sand Trap and Sealed-Gate Chamber, adding Pumped Water to Main Line

life of the equipment. This gives greater influence to first cost and less to annual charges, resulting in smaller size selections. If, however, in the first case depreciation is charged at a rate equal to the amortization rate of the second case, the results will be the same by either method. Upkeep should be distinguished from depreciation as that is necessary to make the equipment serve up to the last month of the last year of its life and will be an item in the annual expense of operating the equipment and should be the same in either of the two cases.

THIS principle is clearly demonstrated in the case of pipe lines conveying pumped water. The first cost is represented by the following items: list price of the pipe, less discounts, freight, cartage, excavation, installation and back fill. Annual charges include as the principal item the cost of the power necessary to overcome the friction of the water when flowing in the line. However, pipe lines do not always wear out but may lose their usefulness through soil depletion, subdivision of land, obsolescence of machinery, etc. A useful maximum life of 20 years would then indicate an amortization charge of about 9 per cent. Excessive rust conditions in iron pipe or alkaline soil solutions in concrete would reduce the life and increase the annual charge. The writer found that a sliding scale of friction factors could be determined which would represent the pipe size having the minimum ultimate annual charge as indicated by the second method. In the table on this page these factors are given in feet per foot of line. Intermediate values can be found by interpolation. Having the friction factor, which gives the slope of the hydraulic grade line, the pipe size is readily determined by the use of tables or graphs. These values are for low pressure heads. Higher pressures mean stronger material or greater first cost. Higher amortization charges then give more weight to first costs which allow increased annual power costs and, therefore, reduced pipe sizes. It should be noted that no reduction in the diameter of the pipe toward the end of long lines is economical as long as the period of seasonal use is constant. This is due to the fact that first cost and friction losses are constant all along the line.

IT IS obvious that an economic balance between the use of pipe and open ditches exists whenever the value of the water, value of the waste land or cost of labor is high. The use of concrete pipe in the orchards of Southern California, for example, in place of open ditches, is increasing rapidly and is economical.

The selection of the best size of a pump for an irrigation supply is a complex economic problem. The development of centrifugal pumps of good efficiency has resulted in their general use and we nw have many types, viz: horizontal (direct connected, or belt driven, single or double suction, single stage or multi-stage); vertical (single suction or vertical submerged) turbines (and multistage verticals), and screw pumps (horizontal or vertical). Each has a particular field and relatively high efficiencies within the pump are now obtained.

It should be noted, however, that for any make and type there is usually but one pump size and one rotation speed, which will give maximum efficiency in lifting a definite quantity rate of water to a definite height. Selection of pump sizes is usually left to pump manufacturers who are willing to give a guaranteed efficiency proposal but the engineer can often exercise judgment in selecting general types. Thus, a belt driven pump to run at its most efficient speed, and driven by a high speed motor instead of a direct connected pumping unit, might be chosen by economic analysis in which the lower first cost of the high speed motor and the better efficiency of the pump are the deciding factors.

The appropriate field for the engineer is in the design of the assembled pumping plant. The design of plant covers such items as pump, motor priming set, check or gate valves, pump house, pump pit, screens, suction line, discharge line, taper pipe connections, electrical connections, etc., all of which enter into first cost and into annual power and maintenance costs. The cost of pumping against unnecessary friction, of drawing water from an excessive depth or lifting higher than necessary represents the interest on wasted capital. A higher initial expenditure may materially reduce the annual charges against capital and upkeep and give low ultimate cost.

ONE of the most apparent losses is in discharging the water at a higher elevation than necessary. Water is pumped, for instance, ot fall noisily into a ditch or standpipe, the idea apparently being to show the value of the service by the noise made. Futhermore the vertical sand trap, in which water rises in a pipe to fall over a baffle-wall, losing its sediment enroute upwards, represents needless waste of power. The same pipe without the baffle-wall, laid horizontally either underground or below the hydraulic grade line with a cleancut gate in one end and water entering and leaving the closed chamber on grade, will represent a saving of power and possibly in first cost.

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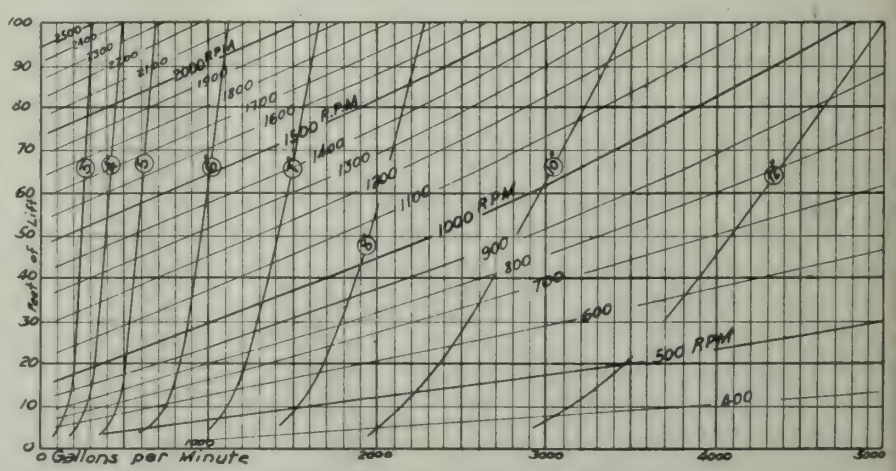

This Chart Shows the Relation between Pump's Size and Speed to Capacity and Lift for Maximum Efficiency. (G. W. Price, 1920 Horizontal Centrifugals.)

What Shall We Do to Protect Our Natural Water Storage Reserves?

Future Supply of Water Depends on Protection of Brush and Forest Cover of the West

By HARVEY S. BISSELL

First Vice President, Conservation Association of Southern California

WHEN Richard Henry Dana sailed around the Horn and reached the shores of Southern California in 1835 to exchange merchandise for hides and tallow, those were the only things that the arid west then produced. Its valleys were sunbaked plains—arid and semi-desert. Today, these valleys produce every crop known to the temperate zone. These valleys, made fruitful by man, are the most valuable, acre for acre, in the United States, because they are highest in production and highest in value of yield. The yearly agricultural products of one western county alone are valued at about one hundred million dollars.

What has wrought this miracle? Intelligence, industry and *water!* With water everything is possible. Without it we return to the desert. Water is the one limiting factor, not only to our agriculture, but to the potential population that the irrigated west can support. Our whole social and economic structure is built upon the permanence of our water supply. Water is our greatest asset and the barometer of our prosperity and growth.

Yet how few of us, whose very existence is dependent upon it, give serious consideration to its perpetuation! We take it for granted, like God's other gifts —the sunshine and the air, until the streams fail or the pump begins to suck air. Then we lower the pump and get water a little longer (perhaps at the expense of our neighbor). We may be able to repeat this a number of times and get water at an ever increasing cost until this cost becomes prohibitive or the supply fails altogether.

This problem is especially pressing in Southern California, but if we discuss it from the point of view of that section of the country, let us remember that it is not a local problem. It is a national problem, and demands national attention.

THERE is only one source of water. That is our annual snow and rain crop. Practically all of this comes during a few months when our water requirements are at their minimum.

It is a matter of common knowledge to those who have studied our water problem that our summer water supply is limited to that part of the winter rainfall which is so retarded from run-off by our watershed forest cover that it is held in the mountains or is discharged from the canyons at a rate that can be absorbed into the subterranean reservoirs of our alluvial valleys.

The amount so conserved for future use is dependent not only upon the amount of watershed area, but upon its quality. Every brush fire reduces that area just so much and reduces the quality of the future cover. It is conservative to say that it takes twenty-five years to restore a good cover and fifty years to restore one as good as we now have in the few places that have so far escaped destruction. When fire destroys the brush cover it so exposes the surface soil on the steep surfaces of our mountains to winter storms that the soil accumulation is eroded away, destroying for many years their capacity of absorption.

As fire succeeds fire the cover is more and more composed of the smaller and poorer varieties, and trees soon disappear. The losses of cover not only are progressive, but cumulative. That is, the cover is constantly deteriorating and the area denuded is increasing for the fire areas of this year are added to those of last year and year before last and so on for the full period required for restoration.

THE RETARDING of the run-off of the winter rains not only conserves this water for beneficial use, but serves another purpose almost equally important. That is, the checking of disastrous floods. Floods come in years of great rainfall or when the rate of precipitation is very heavy. If it were not for the brush cover almost every year would be a flood year. Years like 1914 and 1916 would devastate our valleys and cities to an extent that cannot even be imagined by anyone who has not seen the run-off from a burned-over watershed in a year of real flood.

We can do much to help nature control floods, but do not let us forget that without the cover which is nature's control, we can do nothing. Nor let us forget that since the last flood we have lost over a quarter million acres of good cover.

This cover also serves other purposes not so generally recognized. It has a very considerable effect on our climate. It is recognized that air currents move more rapidly over bare surfaces than over forested areas. This action of the brush, in retarding the fall of the cold night air from the mountains which starts at sunset and brings the evening chill, tends to lessen sudden frost temperature. It also tends to lessen both the frequency and the severity of wind storms. It is also well known that air passing over a green cover is noticeably cooler in summer than that across open spaces. This is frequently noticed when passing a field of green alfalfa on a hot day. This action of the brush cover tends to temper the summer heat. One of the most detrimental atmospheric conditions to ranchers, as well as the most trying to the nerves of all of us, is our hot dry winds. This wind passing over a brush covered area absorbs the moisture transpired by it, and is less hot and dry.

The scenic and recreational value of the mountains where the brush and forest cover have not been destroyed is so generally recognized that it is hardly necessary to comment on it. It is one of the great natural assets of the west—not only as regards pleasure and health, but in the dollars and cents it brings in from tourists. It is inconceivable that people should not preserve such an asset, a thing so vital to our prosperity and our very existence in this semi-arid country, yet we are destroying it year by year; some years only a few thousand acres, but others—like last year—seventy-five thousand; and in 1919 a couple of hundred thousand.

CHAMBERS of Commerce, business organizations, service clubs, women's clubs, legion posts and individuals must take a part in a great program of protection. The Forest Service is active, and alive to the great danger, but circumscribed by lack of funds, and the greatest obstacle of all—public apathy.

Elbert Hubbard describes this as "slipshod carelessness and dowdy indifference." The public neither realizes its danger nor cares. What if forests burn?

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The EDITORIAL

MODERN Irrigation

An Organized Voice for the Forces of Agriculture and Industry Which are Primarily Dependent upon Irrigation.

Published Once a Month
AT LOS ANGELES, CALIFORNIA, BY THE PETROLEUM WORLD PUBLISHING CO. *Editorial and Executive Offices, 626 South Spring Street, Telephone Broadway 3262.* Branches: SAN FRANCISCO—447 SUTTER STREET, *Telephone Garfield 2772;* H. E. TAYLOR, *Manager.* CHICAGO—1163 MONADNOCK BLDG., *Telephone Wabash 8855;* JOSEPH E. O'CONNOR, *Manager.* NEW YORK—503 FIFTH AVENUE, ROOM 308, *Telephone Vanderbilt 8753;* WERNER HAUPTLI, *Manager.*

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By Annual Subscription in the United States and possessions, $2.00; Foreign, $2.50; Single copies on sale in the irrigation country, 20 cents. In ordering change of address, give both the old and the new address. Allow ten days for re-entries on the subscription list. Advertising rates and circulation data upon request. Checks should be made payable to Petroleum World Publishing Co.

VOL. I SEPTEMBER, 1925 No. 3

Weeds in the Garden

THE FIELD of irrigation is, it would appear, peculiarly susceptible to the growth of controversy and dissension. The casual observer, looking over the irrigation horizon, is at once struck by the fact that the most obvious phenomena upon every hand are connected with factional discords.

Arizona is divided over the development of the Colorado River and her sister states of the West are, to a greater or a lesser extent, aroused by the same troublesome subject. The Imperial Irrigation District of Southern California is torn by internal strife, in the course of which public officials of Imperial County, in which the district is located, are threatened with recall, four of the directors are under grand jury indictment, and a policy of re-organization undertaken by them has been ascribed, by unfriendly critics, to motives other than its ostensible basis of economy. In Oregon, irrigation and reclamation organizations are making indignant charges against the national Bureau of Reclamation, asserting that those in control, who are supposed to befriend and foster reclamation development, have turned upon it as traducers and detractors. From other sources, meanwhile, come expressions of approval for the present policies of the Interior Department; and a court decision in Idaho sustains the government in its action in shutting off water to compel payment from settlers. In Washington, enthusiasts who favor the immediate development of the proposed Columbia Basin project are temporarily discouraged over the unfavorable report just returned by an investigating commission, but will doubtless renew their efforts to secure favorable Congressional action, in spite of that negative verdict.

These are but a few of the disputes that flourish luxuriantly in the friable soil of irrigation. They are cited only to show one side of the picture of the industry. They are indications that it is alive; that it is intensely competitive; that it is young; and that irrigation has not yet reached the status of an exact science.

INCIDENTALLY, they demonstrate how hopeless would be the task of a publication that attempted to take sides in these controversies; or that undertook to champion one faction as against another in every temporary dispute or discord. Such a publication not only would be "riding for a fall," quite likely, but would place itself in a ridiculous light with the entire industry in attempting to settle, *ex cathedra,* great controversial questions over which technically informed students of the situation, who are sincerely eager to ascertain the truth, are themselves not able to agree.

But, fortunately for the men who are devoting themselves to constructive work for irrigation, the quarrels and the feuds are only a transitory phase of this great industry. They bulk larger in the public eye, and attract more attention within the irrigation brotherhood itself, simply because they are the more spectacular things. This, too, is a fortunate thing for an enterprise such as MODERN IRRIGATION, which in its third issue, is rapidly getting its bearings, so to speak, with relation to the industry at large. There are plenty of constructive, affirmative things going on in the industry for the observer to mark and record. And these are the things that will endure.

More Significant Things

MORE important to Arizona than the oratory which emanates from the state house, is such a development as that going on in the Roosevelt Water Conservation District, described in detail in another part of this issue. More important to California than a dispute in the Imperial Irrigation District are the plans that are being laid for developments such as the proposed King's River super-district, a $30,000,000 project, or the Pine Flat Reservoir $20,000,000 bond issue that is contemplated. Such are the types of developments which MODERN IRRIGATION will record and give its first attention to.

Constructive work of this kind is going on in all parts of the irrigation country. The recent dedication of the American Falls Dam, in Idaho, with appropriate

POINT *Of* VIEW

ceremonies, marked the culmination of a step in just such a task. A constructive program which will involve the expenditure of over $10,000,000 is now under way at American Falls, to extend over a period of five years to seven years. The American Falls Dam itself represents a cost of $8,000,000.

MODERN IRRIGATION will publish in an early issue a description of the American Falls developments, prepared for this magazine by Warren G. Swendsen, Commissioner of Reclamation of the state of Idaho.

A Statement of Policy

SPEAKING at American Falls on the occasion of the dedication of the dam, Secretary Hubert Work declared: "The United States last year imported about $425,000,000 worth of crude foodstuffs and food animals, exclusive of wool and cotton. It is idle to change our production of farm products and limit them to compel higher prices until we are producing more than we consume."

This statement of policy will be of real interest to every one who is anxious—as so many are—to find out exactly what is the attitude of the Administration toward reclamation. Diplomatically worded statements emanating from "administration spokesmen" have sometimes seemed to carry an implication that farm production ought to be limited, and the extension of agricultural land ought to be delayed, because market prices for the commodities now produced are not all that the farmer would like to see. The attitude of the Interior Department must, necessarily, reflect the policy of the president, and some observers have read into statements from both of these sources a serious lack of enthusiasm for reclamation on the ground that reclamation means, in the last analysis, an addition to the supply of farm produce.

Secretary Work's words, quoted above, ought to prove an effectual refutation of any such impression. By this declaration he has committed himself to a belief that limitation of production is not the way to improve the prices which the farmer receives for his goods. In such a conviction he is in agreement with those who favor an expanding policy of reclamation of the arid lands of the West.

Asking Co-operation

RANCHERS in Southern California are entering upon the last lap of a "dry season", which has been the worse because it has followed several previous dry years. Many of these ranchers are prosperous citrus growers who are apparently, by the ownership of their own pumping plants of adequate capacity, independent of temporary water shortages. They note, however, that they are raising their water from greater depths than usual—obviously the underground supply has been depleted by the abnormal drouth. But they can afford to do the extra work; they have the necessary power and the equipment; and they simply go farther into the earth for their necessary supply.

An article in this issue by Raymond Nebelung, prominent horticulturist of Orange County, California, is addressed primarily to these prosperous ranchers. These irrigators, points out Mr. Nebelung, are really drawing from a common source, and the evidences which they encounter that that supply is abnormally small are the plainest kind of signs that they must rigidly conserve every drop of water which they pump for use in their orchards.

Whether such a warning will be effective depends upon the development of the co-operative spirit in the Southern California rancher. Elbert Hubbard has called the ability to co-operate "the highest manifestation of man's intelligence." Co-operation is a doubly difficult thing to attain, however, when there is no evident penalty attending non-cooperation. The penalty which threatens to visit the Southern California farmer who persists in using water without regard for its conservation or the depletion of the underground supply is the prospect that before that supply can be naturally replenished it will be all consumed, and no one, no matter how generously endowed with pumps and power, can find more of it in the earth.

But the farmer who has learned to cope with the technical, financial and cultural problems of a successful ranch is, as a rule, of more than average intelligence, and, with the situation laid before him as lucidly and completely as has been done in Mr. Nebelung's article, he may be depended upon to do his share in conserving the limited supply for his neighbor and for himself.

A Larger Audience

IN THE WEST there is a peculiar identification of interest between the municipal water works, the water company serving domestic users, and the rest of the hydraulic and irrigation field. MODERN IRRIGATION has seen an opportunity to enlarge its usefulness by incorporating a department devoted exclusively to the interests of water companies of this type. In this issue an humble beginning is made in that direction, which is to be followed up, however, with a consistent effort to direct the editorial policies of the magazine so that it will appeal not only to those who are interested in the development of water for agricultural purposes, but, to an increasing extent, to the large body of technical men and executives who are concerned with supplying the water needs of centers of population, and who often face hydraulic problems as difficult and as complex as those confronting any irrigation project.

Abortive Conclusion of Phoenix Conference Arouses Storm of Editorial Criticism

Governor Hunt Attacked and Defended by Editors of Southwest; Seen as a "Protector" and "Trifler"

THE TRI-STATE Colorado River Conference, which convened August 17, at Phoenix, and its abortive break-up, gave rise, naturally, to many variant editorial expressions as diametrically opposed in their points of view as those represented by the several irreconcilable attitudes of delegates at the conference itself.

Several Arizona organs echo the words of their Governor with approval and unite with him in condemning the Colorado River pact as a defective and unjust document. The Phoenix *Arizona Gazette,* on the day of the conference, before word of its adjournment had been given out, sounded the opposition which a large section of Arizona unquestionably feels to this compact in a leading editorial of which the following paragraphs are representative:

"We have no suggestion or advice for the Colorado River conference which convenes today excepting to say that fair justice must approve every proposal, else it will not finally be approved by the people of Arizona. We cite the Colorado River compact as an example of what we mean. It was thrust upon the people of Arizona with the apparent expectation that it would be swallowed like a sugar-coated pill. But the longer the people studied that compact, the more nauseous became the dose. That compact will never be ratified by the voters of Arizona.

"The Boulder Canyon dam will not be approved by the people of Arizona because it is not an irrigation but a power dam. And Arizona insists that a dam be built far enough up the river to afford the largest possible irrigation by gravity. The future of Arizona depends upon the irrigation of the largest possible portion of its irrigable lands. These lands are the most fertile to be found anywhere. If the Boulder Canyon dam is constructed, no lands may be irrigated in Arizona without pumping, and that is too expensive a process to be at the same time both practical and profitable."

AFTER the sensational break-up of the conference, many Arizona editors charged that Governor Hunt's message was merely the ostensible justification for the debacle, and that the preconceived ultimatum of the visiting delegates was the real obstacle to a harmonious and constructive meeting.

The Tucson *Star* sums the situation up in these words, which are quoted, with approval, by the Tombstone *Epitaph*:

"Governor Hunt's statement was the excuse, not the reason, why the Arizona and Nevada delegates walked out . . Governor Hunt is openly on the defensive; he wishes to protect Arizona's rights in the Colorado River to the fullest extent . . . Certainly it would be folly to accept a flat ultimatum from our neighbors and then discuss the ways and means of handing the river over to them."

The Prescott, Arizona, *Courier,* says, quoting a letter from H. S. McCluskey, Governor Hunt's secretary: "The governor's message, strictly speaking, had very little to do with the failure of the conference. The California-Nevada committee had their stipulation all ready for submission, and it was immediately submitted, demanding unqualified surrender and the signing of an agreement to support the building of a dam at Boulder Canyon . . . We could not agree to any such stipulation."

AFTER the explosion of such a bomb-shell by the Governor the reader would expect to find the Phoenix *Arizona Republican* outspoken in its characterization of what it calls his "wild war-cry," and is not disappointed. The *Republican* is published by Dwight B. Heard, Governor Hunt's political opponent and former gubernatorial rival, and it quite boldly asserts its belief that the conference was never intended to have any other culmination than the one which adjourned it so abruptly. Says the *Republican*:

"No doubt some of the members of the Arizona delegation appointed by Governor Hunt were earnestly desirous of arriving at a solution, but we think that there can be no doubt that a part of the delegation understood that its business was the creation of an impasse such as was suddenly reached.

"The keynote, a wild war cry, was sounded by the governor in his address in the morning session. That created a tenseness which was not relaxed, notwithstanding the assurance of some of the members of the Arizona delegation that their hands were free. From that moment what slender hope there may have been that an agreement might be reached was abandoned."

MUCH of the *Republican's* rebuttal is directed against Governor Hunt personally, but it concludes with a criticism of his policy as unrepresentative of the majority of Arizonans, which is interesting as a statement by an acknowledged spokesman of the attitude held by the considerable anti-Hunt faction of the state:

"We know that this spirit which sways and has always swayed the governor does not animate the great majority of the people of Arizona. They want something done with the river and many of them are agreed upon a definite plan for doing something by which they will make the river a source of revenue for a sorely burdened state whose burden is increasing year by year. It is proposed by co-operation with our neighboring states, to unite with them under the sanction of the federal government and with its financial aid, to create works for the development of electrical energy which will bring to this state a large revenue from power generated within the state and sold and used without the state. We have the most positive assurance that this can be accomplished, if it is undertaken in a spirit of cooperation. And in the accomplishment, no right of Arizona will be surrendered. No future benefit will be foregone."

"It is certain that the Colorado river is going to be developed and it is equally certain that Arizona within this generation or the next, cannot undertake its development alone. We have come to a time in the progress of the country in which it is demanded by industry and population, that latent resources shall be made active, and when dogs shall be driven out of the mangers.

"We believe that we are in the closing phase of the consideration of the Colorado question. We by no means mean that the conference yesterday could have been a determining factor. It could not have had the slightest effect upon the outcome. Its failure does not indicate that Arizona has finally spoken, or, indeed, has spoken at all. There will no doubt be other conferences. What we

(*Continued on Page 28*)

THE IRRIGATION DIGEST

A Monthly Bulletin Board of Brief Facts and Events from Far and Near

Santa Maria, Calif.—In the past five years the number of pumping plants in northern Santa Barbara County has increased from 50 to 455, and more than 100 miles of irrigation pipe has been laid. The increase in both pumping plants and pipe mileage is continuing at a rapid rate.

Phoenix, Ariz.—Nearly 1000 acre-feet of water per day is being pumped by water users in the Salt River Valley. This amount is nearly one-fifth of the total requirements of the area served by the Salt River Valley Water Users' Association. Many association pumps are being replaced by larger installations.

Los Angeles.—A carefully worked-out model of the Colorado River at the proposed Boulder Canyon dam site has been constructed by Walter G. Clark, consulting engineer, and will probably be on display at the offices of the Los Angeles Chamber of Commerce. The model is said to have cost $7,000 to build. It is made of papier mache, on a scale of one inch to twenty feet.

Riverside, Calif.—Proceedings have been initiated by the Palo Verde Irrigation District for the condemnation of a right-of-way for a drainage canal. The district includes 88,000 acres of land in Riverside and Imperial Counties. In the complaint filed in the Superior Court of Riverside County, it is recited that the Colorado River at certain seasons of the year leaves sub-surface waters in the district which render the land alkaline and require the construction of the projected canal for drainage.

Oroville, Calif.—Improvements on the irrigation system of the Oroville-Wyandotte Irrigation District to cost $100,000 have been authorized by its Board of Directors. In addition to the enlargement of flumes and ditches, the chief improvement contemplated is the substitution of 3,200 feet of pipe for five and one-quarter miles of ditch in the Bidwell Bar Canyon.

Villa Park, Calif.— The Villa Park-Olive Farm Center, at its regular meeting, was addressed by S. E. Saunby, member of the public utility committee of the Orange County Farm Bureau, who spoke on "Orange County's Greatest Problem — Water." The speaker outlined four methods of saving water, namely, reforestation, greater spreading activities, closer observation by growers of the amount of water used in their groves, and reclamation of sewage water.

Portland, Oregon.—Forest fires to the number of 854, burning over a total acreage of 12,739 acres, have been fought in the national forest regions of Oregon and Washington in 1925, according to a statement released by the United States Forest Service in August. Lightning was responsible for 600 of the fires, while of the man-caused fires, 104 were ascribed to campers and 69 to smokers. Dry electrical storms have been unusually bad, causing a greatly increased number of fires.

Safford, Arizona. — C. H. Southworth, engineer in charge of construction of the Coolidge Dam at San Carlos, in a recent statement declared that the new route for the Arizona & Eastern railroad across the San Carlos Indian reservation, made necessary by the fact that the impounded waters will cover the old route, has been finished, and the cost of moving the railroad to the new route will be about $1,500,000. The railroad's estimate had been twice that amount.

Nampa, Idaho.—Definite steps have been taken leading toward the dredging of Indian Creek at Nampa. Councilman Rosenlof, of the city board, a former director of the Nampa and Meridian Irrigation District, has been named chairman of a committee in charge of the work. The irrigation district board, the Union Pacific Railroad and the management of the Boise project are to be appealed to for co-operation in completing the task, which will cost only $40,000.

Tucson, Ariz.—The Tucson Gas, Electric Light and Power Company has made a connection with the power system of the Pima Farms Company, by which the 1500-kilowatt turbine plant of the latter organization will be available for furnishing current to the power company. The Ivydale-Owen Company, south of Tucson, is preparing to install a new electric plant, at a cost of $100,000, for the operation of its pumping system. Power will be furnished by a large Diesel installation.

Vale, Oregon.—The executive committee of the Oregon Irrigation Congress, in session in August, adopted and forwarded to Hubert Work, Secretary of the Interior, a strong resolution requesting that construction work be commenced without delay on Oregon projects which have been investigated by his department and pronounced feasible. The executive committee includes: W. A. Steward, of Baker, chairman; Wilford Allen, of Grants Pass; R. H. DeArmond, of Vale; John S. Beall, of Portland; Geo. Aiken, of Ontario; D. H. Nelson, of Pendelton; C. G. Brownell, of Portland.

El Centro, Calif.—In renewing the contract under which the Imperial Irrigation District is allowed to construct brush weirs in the Colorado River to raise the water above the intake during the summer season, the Imperial district and the Yuma County Water Users' Association have negotiated an agreement the terms of which are more stringent than any previously in force covering the matter. The Imperial district has been placed under a bond of $500,000 to indemnify the Yuma organization for possible damages resulting from the construction of the weir. It is specified that no rock may be used in its construction.

Power Developments of 1925 Show Big Increase

Report of Geological Survey Indicates Ten Per Cent Gain Over 1924; New York Leads States

The Department of the Interior, through the Geological Survey, has released a report on the developed water power of the United States in 1925. The total capacity of water wheels installed in plants of 100 horsepower or more, in March, 1925, was about 10,038,000 horsepower, an increase of about 951,000 horsepower, or nearly 10½ per cent, over the total capacity of water-power plants in 1924 (9,087,000 horsepower). Of this increase 99 per cent was in electric public-utility plants and 1 per cent in manufacturing plants.

New York continues to lead the rest of the States in the amount of developed water power. The five leading water-power States in order of their rank and the amount of developed water power for each are as follows: New York, 1,713,551; California, 1,531,480; Washington, 560,693; North Carolina, 534,600; Maine, 476,627. North Carolina has moved from fifth place in 1924 to fourth place in 1925.

The report also contains records of the developed water power for 1924 and 1921 and the estimates of potential water power for 90 per cent and 50 per cent of the time computed in 1924. Based on present practice at fully developed waterpower sites the undeveloped water power in the five States leading in developed water power will permit of the installation of the following additional capacities in water wheels, expressed in horsepower: New York, 4,734,000; California, 7,145,000; Washington, 9,672,000; North Carolina, 526,000; Maine, 920,000.

The report indicates that water power development in the Middle Atlantic, South Atlantic, and East-South Central States is progressing more rapidly than in any other sections of the country. New England's relative standing continues to decrease. Development in the Pacific States during 1924 failed to keep up with the rate maintained by the rest of the United States.

Ramona District Organized

Ramona (Calif.) Irrigation District was officially organized in accordance with law on August 11, after official canvas of the poll of the question of organization had been completed and revealed a vote of 87 for the organization and four against it. R. L. Jerman was elected president of the district, and Miss Elizabeth Seay secretary.

Irrigation in Montana

Montana has nearly two million acres in irrigation districts and reclamation projects, according to records in the office of E. S. Heidel, State Engineer of Montana. There are 62 private districts organized under the State irrigation district laws, six projects under the Federal Carey Act, four under the United States Reclamation Service, and three under the Indian Service.

The largest of the private districts is the Toole County district, comprising 280,000 acres. The Crow Creek district in Broadwater County, has 52,273 acres; the Lower Yellowstone project in Richland County with 44,381 is third in size.

The Carey Act projects are: Billings bench, Billings, 39,000 acres; Big Timber, 30,599 acres; Valier, 180,000 acres; Teton, Helena, 17,725 acres; Flatwillow, Lewiston, 26,048 acres; Little Missouri, Butte, 26,000 acres.

The Federal Reclamation and Indian Service projects are, with their ultimate irrigable acreages: Huntley, Yellowstone County, 32,473; Milk River, Hill, Blaine, Phillips, and Valley Counties, 154,101; Sun River, Cascade, Chouteau, Lewis and Clark, Teton, 158,851; Lower Yellowstone, Eastern Montana and Western North Dakota, 59,259; Blackfeet, Glacier and Pondera, 107,500; Flathead, Missoula and Sanders, 124,500; Fort Peck, Roosevelt, 153,394.

How Evaporation Varies

Measurement of the amount of evaporation from a water surface has been made at numerous places by the U. S. Department of Agriculture. There is a wide variation in the depth of evaporation, it being 27 inches per year on the top of Pike's Peak and 101 inches per year at Prescott, Arizona. At Denver the evaporation is 69 inches, at Cheyenne 76 inches, and at Salt Lake City 74 inches.

The two things that cause a big evaporation are wind and heat. Probably of the two the wind has the greater effect, and during the hot summer days a high wind makes a very great difference in the evaporation. It is noted that the evaporation at Cheyenne and Salt Lake is approximately the same. The mean annual temperature at Cheyenne is 46 degrees and at Salt Lake 54 degrees. The difference in temperature is offset by the larger amount of wind at Cheyenne, the average hourly wind velocity there being 13 miles per hour, and at Salt Lake City the average is 7 miles per hour.

Idaho Court Sustains U. S. in Water Decision

Government Victor in Award by Judge Dietrich; Temporary Restraining Order Dismissed

That Government officials may shut off the water supply of settlers who are delinquent in their drainage payments was ruled in a memorandum decision handed down in August by Judge F. S. Dietrich of the Federal Court at Boise, Idaho.

The decision represents a victory for the government counsel, who have appeared for J. B. Bond, manager of the Boise project, defendant in an action brought by S. Clare Mower, of Caldwell, a settler. The decision also vacates the restraining order issued by Judge Brinck of the Ada County district court.

Mower claimed that the government had no right to shut off the water, after having started delivery. In regards to his plea for estoppel, Judge Dietrich holds that the "facts averred are thought to be insufficient. It may be that the defendant had induced the plaintiff to put in his crops during the current year with the promise that the demand in question would not be pressed until the close of the season, and if the plaintiff were financially unable to meet the demand, the defendant, though an agent of the government, should be enjoined from now shutting off the water in violation of such understanding. But the pleading does not go that far; it alleges only that the defendant did not promptly, at the beginning of the season, shut off the water. No inducements or misrepresentations are charged, and as before indicated, the allegation of the plaintiff's inability to pay is qualified and far from being satisfactory."

The plaintiff also contended that the waters remained the property of the state, under the state constitution, ratified by congress, and that if the government sought to divert water it must of necessity put itself on the same footing with other appropriators and comply with the state laws. The government contended, however, that until appropriated under state law, the waters of such streams as the Boise River are the property of the government, to be used without respect to state laws. The decision states that "No case has come to my attention fully supporting this view, but in some of the decisions from high source are to be found intimations that the government retains a measure of interest or control of some character."

Columbia Basin Investigators Submit Unfavorable Report on Project

A SPECIAL commission appointed by Secretary Hubert Work to investigate the feasibility of the proposed Columbia River Basin reclamation project has submitted its report, and the gist of its decision is that the time has not yet arrived when local and national interests require its construction.

The report points out that the cost of the Basin project has been fixed at $193,260,000, which is $158 per acre and that the Bureau of Reclamation is not possessed of the information needed to formulate a development plan as costly and complex as the one outlined for the Columbia River Basin. The commission making the report includes Elwood Mead, Commissioner of Reclamation, who is chairman, and John H. Edwards, Assistant Secretary of the Interior. The report reviews the investigation as follows:

"Homer J. Gault, for many years an engineer in the Reclamation Service was selected to conduct the work in the field; he made a thorough survey and investigation of the engineering problems of the project during 1923, being assisted by soil experts from the Department of Agriculture, and representatives of the Geological Survey who made studies of the water resources and of geological conditions as related to the location of various features. Mr. Gault's report was submitted in March, 1924. In this he outlined the result of his field work, discussed various alternative plans, and included the findings of the soil, geological, and water experts.

"His report was reviewed by a board of engineers taken from the staff of the Bureau of Reclamation, the members being A. J. Wiley, James Munn, and J. L. Savage. Their report devotes itself largely to a discussion of the reasons for the large increase in the estimates in the Gault report over those of former reports prepared under the direction of the State of Washington. Their conclusion was that this arises from differences in the estimates as to carrying capacities of the canals, the quantity of water required, its losses in transit, and allowances for overhead expenditures and contingencies; and that the Gault report presents a fair estimate of cost under the conditions prevailing at that time.

"On further consideration, it was decided, however, by your commission, to have a further review of Mr. Gault's report, and an independent investigation of the project which would include, along with engineering features, the settlement and farm development problems. This was required to make this report conform to the recommendations of the Committee of Special Advisers on Reclamation. This Board of Review was therefore selected, to include men who were not only eminent as construction engineers, but who were also familiar with the economic and agricultural aspects of reclamation. It was composed of six members: Louis C. Hill, of California; Charles H. Locher, of Maryland; Richard R. Lyman, of Utah; Arthur J. Turner, O. L. Waller, and Joseph Jacobs, of Washington. The report of this board was submitted in February, 1925. It considered five different plans, or schemes of development. The one favored embraces 1,224,000 acres which with the exception of 170,000 acres of pumping lands is to be irrigated by gravity, using the waters of the Pend Oreille and Spokane Rivers. The construction cost of the works is fixed at $193,360,000, which is $158 an acre. This estimate includes provision for drainage and contemplates the lining of canals to the border of each unit.

"This report agrees with previous reports in regarding the project physically feasible; the land is fertile, the water supply adequate, and climatic conditions make possible large yields of general farm crops, and a variety of orchard and garden products.

"The outstanding feature of this report is the attention given to the agricultural and economic requirements of the project along the lines of the recommendation of your Committee of Special Advisers on Reclamation. Two of the board's economic conclusions contained the following recommendations:

" 'That the State should assume its proper share of responsibility for collecting payments from the settlers, and should also bear its proper share of the losses, if any, incident to the development of the project.

" 'That the Government should clear and level the land and provide a reasonable financial credit for necessary farm improvements. Also as a guarantee against land speculation, and to insure that the settler secures the land at its fair value; that the Government acquire title to all the irrigable land within the project.'

"Your Commission has no doubt that the time will come when local and national interests will require the construction of these works, and the utilization of these immeasurably valuable resources. It does not believe, however, that this time has arrived; or that the Bureau of Reclamation is possessed of either the information or the experience needed to formulate a development program as costly and complex as the one outlined and advocated in this report."

Airplane Irrigation Survey

Engineers in charge of the preliminary survey of the Moorpark-Conejo irrigation district in Ventura County, California, will use airplanes in making a survey of the section.

Water 9500 More Acres

New canals which will carry water to 9500 acres of land in the Jordan Valley, Oregon, Irrigation District, have been completed by Morrison and Knudson, contractors.

Equipment Men in Session

Members of the Western Irrigation Equipment Association will meet at Sacramento, on September 11, in the regular bi-monthly meeting of the association, which will also be the regular annual meeting for the election of officers. The date of the meeting was planned purposely to fall during the California State Fair at Sacramento so that the equipment manufacturers and dealers attending the sessions could enjoy the fair as well, in which many of them are interested as exhibitors. Officers to direct the work of the association for the coming year will be elected.

Study Wasco County, Oregon

THE DALLES, OREGON.—Engineers, orchardists, and chamber of commerce executives of The Dalles recently completed a survey of the watershed of northern Wasco County and its possibilities for water development for irrigation. As the result of the survey, a complete report will be prepared and issued by the Chamber of Commerce as a preliminary to actual development work. Those making the recent trip which completed the reconnaissance of the water resources of the section were: W. S. Nelson, John Odell, and L. A. Schanno, representing the Chamber of Commerce; T. A. Sammis, Jr., Ray F. Kelley, Richard M. Weber, John Moore and Raymond Church, interested orchardists; R. A. Brouhard, photographer; David Glass, engineer, T. Leland Brown and George P. Couper.

IRRIGATION MANAGEMENT

SPECIAL PRECAUTIONS NECESSARY WITH LOW WATER-LEVEL

By RAYMOND NEBELUNG

President, Farm Bureau, Anaheim, California

FOLLOWING several unusually dry seasons, it should not be surprising if there is a general lowering of the water level in the wells throughout an irrigation district. In the neighborhood in which the writer lives, this lack of precipitation has been apparent, not only locally, but also in the mountains which form the watershed of our locality. Lakes and streams are low and the situation generally is one that calls for co-operation on the part of all irrigators in making the most possible use of all water and allowing none to be wasted or used when not necessary.

There is a certain definite amount of water that should be used for best results to the growing crop, whether it be tree or truck. More or less than this amount will cause injury to the crop or waste of water and sometimes both. The grower should have some means of determining this optimum amount.

The object of this article is principally to try and show by what means water can be conserved following dry years such as we have recently had in southern California and which periodically affect all parts of the irrigation country. We know, in our particular district, that this must be done, as figures can be presented to show that there is considerably more water being taken out of the underground basin than is being run into it. Such a condition cannot continue indefinitely, and each irrigator owes it to himself and to the entire district to do whatever is possible to save water. Merely because a grower has his own plant and can pump all the water he needs is no excuse for using more water than is necessary for the best condition of his trees. This water all comes from a common source of supply and every bit that is removed from this source leaves that much less for future use until the supply is replenished much more rapidly than it has been during the last several years.

Probably the most simple method for the grower to practice, where he wishes to make these determinations himself, is by the use of a soil auger. A five-foot auger will give him sufficient information as, except in the case of very large trees, he is not interested below four feet. This depth of irrigation will insure sufficient moisture for the average-sized mature orange trees. Usually any moisture below fiive feet will be wasted.

Before commencing an irrigation, the grower should thoroughly test out all portions of his orchard with the soil auger to determine whether there is an actual need for irrigation. If the soil feels moist to the touch and sticks to the auger, it is almost certain that there is still sufficient moisture in the soil and that it will be probably a week or more before it will be necessary to apply water. The practice of irrigating before the soil and the growing crops are in need of it is not only detrimental to the crops, but is an actual waste of water.

IF THE grower has found it necessary to irrigate, he should then know what is becoming of his moisture, that is, how deeply it is penetrating into the soil. Too much irrigation is done by guesswork, the water being run over the soil until it reaches the end of one furrow and then turned into the next ones. An auger examination following an irrigation will often show that the moisture has penetrated to only a depth of a foot or sometimes less on the heavier types of soil and to below five feet on the sandy types. This is causing injury on both types of soil, the heavier types not receiving enough moisture, and the sandy types having the soluble plant foods washed down below the feeding area. If the grower will determine the penetration following an irrigation, he can make corrections by the time he again irrigates, running the water longer on some portions and running it more rapidly and in less time over other portions. If he can get an average of a four-foot penetration on all types of soil, he will be giving his trees the irrigation that is required. This takes practice, and only by examining down to a depth of four feet can a grower know what is actually taking place.

As a means of conserving our moisture supply, the writer wishes to offer the following suggestions to users of irrigation water and irrigation companies. While these may not be in exact order of importance, still they all have a direct bearing upon the amount of water that can be saved.

The first method that should be used is to make a careful test of the soil to determine when it is necessary to irrigate, and not irrigate until that time. Following the irrigation, there should be another test made to determine the depth of penetration, so that especially on the sandy types of soil there will be no waste of water below the feeding area.

Next is the matter of length of irrigation runs. It is often found that where there is a run of over 15 trees there is a waste of water and of plant food near the pipe line. By shortening the runs to not more than 15 trees on the heavier types of soil and eight to ten trees on the sandy types a more even distribution can be obtained and the water will not be wasted below the feeding area.

THE MATTER of cover crops is also important, especially at a time of drought, in conserving the water supply. It is well known that a cover crop requires water more often than the tree crop, and if growers in this district, for instance, should experience a dry fall this year, it will mean that considerable more water will have to be used to keep this cover crop alive than will be necessary where no cover crop is being grown and water is applied only for the trees. While rather late to mention at the present time, this applies equally as much or even more so to summer cover crops, many of which can be seen growing in

Pacific Pumps

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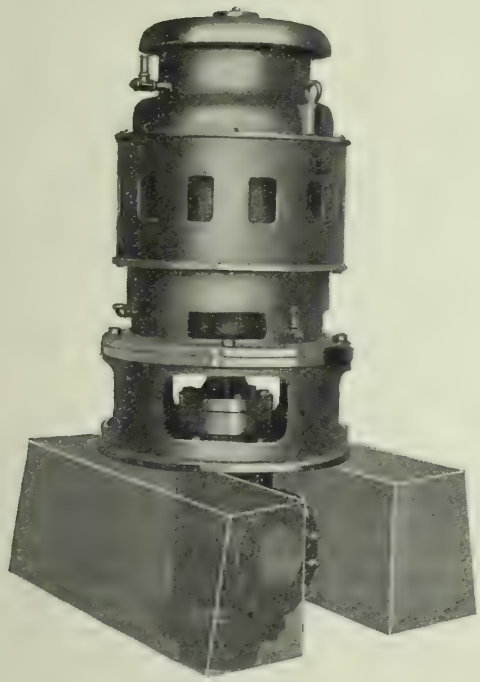

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Lomita Water Company, Lomita.....One
Michigan Land & Water Company, E. Pasadena One
Montebello Land & Water Company, Montebello One
Moorpark Farmers Water Company, Moorpark..Two
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Oildale Mutual Water Company, Bakersfield.....One
Omaha Water Company, Covina.....One
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various orchards at the present time. Every grower should consider seriously before planting a cover crop this fall and he may be doing a good service to his community by discing in any growing summer cover crop he may have, if he feels that it is going to require many extra irrigations.

A method of irrigating which is coming into popular favor in certain southern California districts, is of employing a qualified chemist to make analysis of the soil to determine the wilting point and the amount of available moisture and to notify the grower when his soil and trees are in need of water. In almost every instance where this system is being used, there is less water being applied than formerly and in some cases the amount is being cut in half. This means that on these groves only 50 per cent of the amount of water that was formerly used is now being used, resulting in an actual saving of this amount to the underground water system or to the irrigation companies. This decreased irrigation has also resulted in the trees being in much better condition, as too much water was being applied formerly.

A DIFFERENT method of distribution by water companies would also result in a saving of our water supply. A grower often has to take water when it is his turn in that particular run or else wait probably three weeks or longer until it will reach him in the next run. He does not need the water at the time, but knows that his trees cannot wait three weeks longer, and of the two evils he chooses the lesser one; that is, he irrigates before it is necessary. If the grower could receive the water on order, he probably would wait six or seven weeks between irrigations instead of four or five, and would save one or two irrigations during the season, which, multiplied by several thousand acres, would mean a great saving for the future in our supply of irrigation water.

While the writer does not wish to appear unduly alarmed about the water situation, still it is time that the grower who is absolutely dependent upon an adequate irrigation water supply begins to realize that he can do certain things to insure his supply for the future. Water receding in the wells can only mean one thing; that is, that the supply in the underground basin is getting lower. There is only a certain limit which water can be lifted and when the water level gets below this, some other means of bringing it to the surface will have to be found, if there should be an adequate supply left to bring to the surface. It is a matter of co-operation among all the growers and water companies and each must do his share.

Phoenix Conference is Disappointment

(*Continued from Page 16*)

"The Arizona Committee replied that it was ready to negotiate with reference to a project at Boulder Canyon or any other site provided the details with reference to that development could be worked out in a manner satisfactory to Arizona, and in the event an agreement could be arrived at, the Arizona Committee was fully prepared to urge co-operation to the fullest extent in such development.

"This statement of the position of the Arizona Committee was not acceptable to the California and Nevada delegations, and their members withdrew from the conference holding a caucus among themselves."

A JOINT statement prepared by the chairmen of the California and Nevada committees was also given out, in which it was charged that Governor Hunt's "language and manner" were responsible for the break-up of the conference.

The statement follows:

"When we came over to Arizona we were led to believe by the advance statements of Governor Hunt that this committee appointed by him was to act without any interference on his part and that it was not in any manner controlled by him but had unrestricted authority to act. When we arrived here, much to our surprise, Governor Hunt appeared with printed statements of his speech embodying his opinions and views as to the Colorado River and as to the matters which would be taken up and discussed at this meeting. He stated his views in positive langauge and in such a manner that we could see no hope of adjustment.

"The Nevada delegation had only one request to make and that was that Arizona withdraw its opposition to the construction of a dam at or near Boulder Canyon. This the Arizona delegation refused to do. All that was asked of Arizona in this respect was, that, in the event we arrived at an agreement on other matters then there should be included in that agreement, in substance, a statement that such opposition would be withdrawn.

"It is the purpose of both Nevada and California to do everything possible to expedite the development of the Colorado River. For years, this great resource has been wasted to the disadvantage of us all. We are as much interested in the development of Arizona as we are in either Nevada or California, but it is apparent from the attitude of Governor Hunt, as expressed by him in his speech, that, at least, he is not in accord with us in this particular and that such an agreement cannot be arrived at by any committee appointed by him. It is true that the Arizona committee stated that they would act independent of the Governor, but in view of the fact that it was a committee appointed by the governor and under the law must report back to the governor, which report the governor could entirely disregard, we saw no further use for discussion.

"RALPH E. SWING,
"Chairman for California.
"CHARLES P. SQUIRES,
"Chairman for Nevada."

The California delegation included: Senator Ralph Swing, Senator L. L. Dennett of Modesto, Assemblyman A. C. Finney of El Centro, and Assemblyman Walter J. Little of Hermosa Beach.

The Nevada delegation was announced as: C. P. Squires of Las Vegas, Levi Syphus of St. Thomas, George B. Cole of Carson City, state comptroller, and George W. Borden of Carson City, state highway engineer.

Editors Are Divided on Arizona's Governor

(*Continued from Page 22*)

mean is that the delays of the nearly three years that have elapsed since the federal government stood aside to let the Colorado states try to reach a plan of co-operation have become intolerable and obstructive of progress."

THE *REPUBLICAN'S* voice is not, it appears, the only one uplifted in condemnation of Governor Hunt from within his own state. More than a few newspapers consider that politics flavor such utterances as those of his Phoenix statement.

The Casa Grande (Arizona) *Bulletin,* comments: "The people are now well convinced that his idea of damming the River with his brand of politics is the bunk."

The *Five Points Star,* published at Phoenix, describes the governor as a man who "stands alone, a subject of ridicule and criticism that is growing by leaps and bounds," and the Douglas *Dispatch* says: "He has done what was expected of him." The Tucson *Citizen* remarks: "The governor's lack of the constructive faculty has never been more clearly shown."

A veritable storm of criticism is heaped upon the Arizona executive, however, from California newspapers, and the gazettes of other states, when they comment, are prevalently antagonistic. The following are characteristic comments, and they are usually enforced by

arguments that the Colorado River is not the exclusive possession of Governor Hunt nor the state of Arizona:

"Governor Hunt's attitude places him in the category of a trifler."—Anaheim, California, *Bulletin*.

"The address delivered by Governor Hunt was much more intended for Arizona consumption than for the ears of the delegates to the conference."—San Bernardino, California, *Sun*.

"Those who know Hunt were not at all surprised by the failure of the Phoenix conference."—Tustin, California, *News*.

Realtors Study Irrigation

Men who sell land were shown glimpses of the work that makes land salable when three hundred real estate men of Central California recently were the guests of the Modesto Real Estate Board on a tour of the Don Pedro and La Grange irrigation projects of the Modesto-Turlock irrigation districts.

Realtors of Stanislaus County provided automobiles in which the delegates from many parts of the state were taken over the districts. The Don Pedro dam, rising 300 feet above the bed of the river, impressed the visitors mightily as a symbol of what is being done to make western land more valuable.

Rural Population Declines

The farm population of the United States decreased approximately 182,000 during 1924, according to estimates based on a survey of 25,000 representative farms made recently by the U. S. Department of Agriculture. This is a drop of 0.6 per cent during that year, the estimated farm population on January 1, 1925, being 31,134,000, compared with 31,316,000 on January 1, 1924. This estimate includes not only the agricultural workers but all men, women, and children living on the farms on that date.

Farmers as Power-Users

The American farmer ranks next to the railroads and leads both the manufacturing and mining industries in the use of power, says *The New Reclamation Era*. Approximately 60 per cent of the power utilized on farms is animal power. Tractors account for nearly 17 per cent, motor trucks about 4 per cent, stationary engines 12.5 per cent, windmills a little more than 1 per cent, and electrical installations 5.5 per cent. The use of this power, together with labor-saving machinery, has greatly benefited the American farmer. The average farm worker now cares for approximately three times as many acres of crops as did the worker of 75 years ago.

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HYDRAULIC ENGINEERING

Dealing with the Practical Problems of the Operating and the Consulting Engineer

DESIGN AND CONSTRUCTION OF SMALL EARTH DAMS

By W. H. NALDER

Engineer, U. S. Bureau of Reclamation

THE construction of an earth dam of any considerable size or one that impounds any considerable volume of water should be done with great care. The investment is great, and the risk of losing this investment and the danger of imperiling the lives and property of others in the event of the failure of a dam should be carefully considered and amply guarded against. The various States have enacted laws placing the construction and maintenance of such dams under the supervision and control of the State engineer or other authorized official, and no person should proceed with the construction or use for the storage of water of any such structure, regardless of size, without first ascertaining that he is acting fully within the laws of the State.

EARTH dams may vary in size from small canal banks to large reservoir dams, perhaps 200 feet or more in height. The factors determining their individual design are numerous and are dependent upon such variable quantities as the nature of the foundation, the climate, the materials available, and the use to be made of the reservoir created. On account of these conditions the design and construction of earth dams often require the very highest type of engineering skill, experience, and judgment. This article, however, will be limited to the nontechnical discussion of the design and construction of small dams and embankments of a type usually required for small farm reservoirs such as can readily be constructed by teams, wagons, and scrapers and without more elaborate construction equipment. The following discussion should be considered only as outlining general methods and not as being applicable to all conditions.

THE preparation of the foundation for an earth dam is of great importance. The most suitable material on which to place an earth dam is sandy or gravelly clay. However, for a farm reservoir it will generally be necessary to use whatever foundation is available and to take suitable precautions to prepare this foundation so that an economical and safe dam will result.

The first thing to be done is to remove from the entire area to be occupied by the dam all sod, brush, trees, roots, and other perishable matter and all soil to a depth equal to that penetrated by the roots. All this material should be wasted. If pockets of quicksand or clean sand are found in the foundation, these also should be removed, or special precautions taken to care for them under competent engineering advice. If the exposed material is sandy or gravelly clay of substantial depth, the embankment for small dams may be safely built directly upon it, but it should first be scored with a plow to provide a bond between the foundation and the embankment.

If solid rock is encountered in the foundation, low concrete cut-off walls should be built parallel to the top of the dam. These cut-off walls should extend at least 12 inches into the solid rock and should rise above the rock surface from 2 to 4 feet according to the height of the dam. Parallel cut-offs should be built at intervals generally not exceeding 20 feet throughout the area of the foundation that consists of solid rock.

If the foundation consists of open gravelly or sandy material that would be freely draining, an open cut-off trnch should be excavated to the more impervious underlying material and this trench filled with impervious material and made a part of the impervious portion of the main dam. Earth dams should not be built on a shale or slate foundation. If running springs are encountered in the foundation, the site should be abandoned or competent engineering advice secured before proceeding further with the work.

THE arrangement of the material in the embankment and the method of placing and compacting it will depend upon the relative quantities and kinds of material and the available moving equipment. If sandy or gravelly clay in abundant quantities is available and the height of the embankment to be built is not over 50 feet, the material may be deposited uniformly over the embankment. The material may be transported and handled with teams and scrapers or dump wagons. The material should be deposited in horizontal layers not over 1 foot thick and the travel over the embankment in placing the material should be so distributed as to secure as thorough and uniform a compacting effect as practicable. If this compacting does not produce a firm and solid embankment at all points, further compacting may be obtained by sprinkling with water and rolling with a steam or horse-drawn roller. Most farm tractors make good rollers for this purpose, or one can be made by placing an axle through several cast-iron car wheels and rigging a tongue to it so that it may be drawn by teams back and forth over the embankment. The corrugating effect of the flanges of the car wheels is especially effective in compacting moist earth. An economical corrugated roller can also be made by filling with concrete a section of corrugated metal culvert pipe about 3 feet in diameter.

It is quite often the case that the amount of sandy or gravelly clay or other available material that will form an impervious embankment is limited and insufficient to build the entire embankment. In such cases it is necessary to use this material to the best advantage and to supplement it with other material that is available in order to make a safe, stable, and water-tight dam. Under such circumstances it is often best to place the best water-tight material in a puddled core in the bdy of the embankment by sluicing or ponding methods, but it is not recommended that this be done except under skilled engineering supervision

For small embankments satisfactory results, under these circumstances, can

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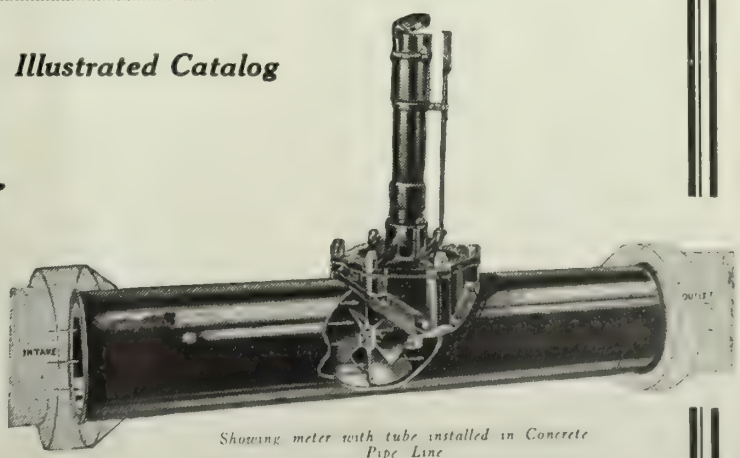

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usually be obtained by placing the selected water-tight material in the upstream portion of the dam and by constructing the downstream portion of heavy, stable, freely draining material, such as sand, gravel, and stone. Such material should be so distributed that the coarser material is on the downstream slope of the dam, changing gradually to the finer and more claylike material as the impervious material in the upstream portion of the dam is reached.

The material should be placed and compacted in a manner similar to that described for homogeneous embankments, but where heavy gravel or rock fragments are used the compacting operations may be omitted. No general rule can be laid down as to the amount of impervious material that it is necessary to use in a dam. For the type of embankment contemplated in this description the thickness of the impervious portion should be not less than one-third to one-half the horizontal thickness of the dam at any elevation.

PROPER dimensions for an earth dam depend upon a number of factors. The top width should be sufficient to form a substantial structure and generally should be wide enough to provide a suitable roadway for crossing from one side of the canyon to the other and for making repairs to maintain the dam and related structures. A top width of 8 feet is suggested as a minimum for small dikes. For dams over 20 feet in maximum height this should be increased up to about 20 feet for dams 50 feet or greater in height.

The top of the dam should be sufficiently high above the highest water surface in the reservoir to obviate all possibility of the dam being overtopped even by spray or splashing during high winds. For the very smallest reservoirs the height above high water should not be less than 2 feet and for most ordinary circumstances not less than 5 feet. For reservoirs of any considerable size and for all dams 50 feet or more in height this height should be not less than 8 to 10 feet. The minimum upstream and downstream slopes of the dam are fixed in some States by statutes. The downstream slope should be sufficiently flat to avoid weathering.

For the type of dams contemplated in this article this slope should never be steeper than 1½ horizontal to 1 vertical, even for the smallest dams, and in general should not be steeper than 2 horizontal to 1 vertical. The upstream slope should in general be flatter than the downstream slope and in general should not be steeper than 3 horizontal to 1 vertical. Unless the upstream slope is protected by some suitable pavement such as hand-placed riprap or heavy rock facing it will usually be impracticable to maintain a slope as steep as 3 horizontal to 1 vertical.

Often the most important feature of an earth dam is the spillway. No earth dam should be constructed without ample provision for the safe passage of the maximum flood that can occur with the reservoir full and without encroaching dangerously upon the freeboard of the dam. Spillways for earth dams should in general not be controlled by gates that must be operated by an attendant, but should be automatic. The detail design of spillways is affected by many considerations and each spillway must be adapted to the conditions existing at the site.

EVERY reservoir formed by an earth dam must be provided with suitable outlet works to provide for drawing off the stored water as required and for controlling the discharge from the reservoir. It is most desirable to have the outlet works independent of and apart from the dam, but for the type of earth dam contemplated, it is usually necessary to construct this outlet through its base or at best in a tunnel through one abutment.

The main consideration in outlet works for earth dams is to make them safe from danger to the dam structure. The pipe or other conduit laid through the base of an earth dam should be amply strong to withstand cracking or fracture under the heavy load of earth fill placed upon it.

The controlling gate should be placed at or near the upstream face of the dam to avoid the possibility of introducing water under pressure into the body of the dam. Ample cut-off collars should be provided to prevent percolation of the water along the outside surface of the outlet conduit, and great care should be taken in compacting the earth fill around this conduit. The water should be discharged at the outfall end in such a manner as to avoid all danger therefrom to the downstream toe of the dam.

On the whole it is believed that there is no structure usually connected with irrigation works that is so subject to varying local conditions and that requires the exercise of more care and mature judgment, to the end that economical and safe construction may be obtained, than earth dams. It is therefore believed that no such dam should be built except under the advice and supervision of a competent and experienced engineer.

Developments on the Roosevelt Water Conservation District, Arizona

(*Continued from Page 12*)

or about one-half cent per KWH up to a maximum of 416 2-3 KW for each $100,000 paid into the Assocaition to defray the actual cost of power plant. Six such equal payments are contemplated within a period of ten years time. This $600,000 total payment will give the District all its power at about one-half cent per KWH. The rate without making investment in power is about one and one-half cent per KWH.

THE JASPER-STACY Company of San Francisco are the contractors doing the construction work. Two million dollars worth of six per cent bonds have been issued and taken up by a bond syndicate. An additional million dollar issue has also recently been sold. The construction work, to date, has cost $735,000. Funds have been turned over to the Association for the canal lining, the bulk of which will be done this winter.

Reed and Baker of Phoenix, Arizona, were engineers for the District and were associated during construction with H. I. Wood, representing Fred H. Tibbetts of San Francisco, the Consulting Engineer.

The principal crops will be cotton, melons, alfalfa and maize. The northerly portion of the District will probably be devoted to the growing of citrus fruits, grapes, dates, etc. All of these products have been successfully grown in the past on the project with success where water has been available. The easy means of transportation on the paved highways adjacent to the project and the two railroad lines through the District with the rich soil should cause a rapid development which will be similar to that in the best portions of the Salt River Valley. A substantial portion is under irrigation from the wells this year and it is expected that more than half will be under irrigation next year.

San Jacinto Votes Bonds

A bond issue of $44,000 was approved by the voters of San Jacinto, California, by a vote of 186 to 16 in an election held during August. The city water system is to be practically replaced with the funds realized from the sale of the bonds. New pipe will be installed in almost every part of the system and the pumping equipment will be improved.

The Irrigation Engineer Counts the Pennies

(*Continued from Page 18*)

The power bill for lifting one acre foot of water one foot, net height, should be about 2½ cents while the combined amoritzation and operating charges should be less than 8 cents. This indicates an annual cost per acre of about $5.00 when lifting water 25 feet. The recent California State Bulletin by Harry F. Blaney, summarized by Mr. Blaney in the August number of MODERN IRRIGATION, shows the extent to which the average pumping plant exceeds this figure. While the efficiency at the pump may be as high as 75 per cent, the overall efficiency seldom exceeds 50 per cent, which means high annual power bills. These extra losses are usually "velocity head" losses which may often be reduced by foresight in designing the pipe connections.

Economic selection as regards open channels is not generally as simple as has been shown here in pipe and pump design, but an analysis can be made to determine the benefits to accrue between the use of flat, low velocity canals and steep, swifter ones. In the former we have more land served, on the latter smaller cross-sections and lower first cost.

THE CROSS-SECTION for a known grade also admits analysis. The "best discharging" section is the one whose "ideal" sides and bottom are tangent to the circle drawn about the middle point of the water line as a center. It is rather deep but will deliver more water for equal area of cross section, bank slope and water slope than any other section. Due to its depth the unit costs may be higher, but for a required capacity the yardage is less, less area is exposed to evaporation and the velocity is higher, allowing the water to arrive at the land more quickly and reducing seepage losses. For lined canals or flumes this section is ideal as it also reduces first cost, due to its shorter perimeter.

In the location of field ditches economics enter in several ways. Later subdivision should not require expensive ditch relocation. If possible, the spacing of the laterals should be parallel to tree rows and multiples of tree space distances, to avoid lost tree spaces, since each tree lost to an orchardist means the lost income from an equivalent investment of many dollars.

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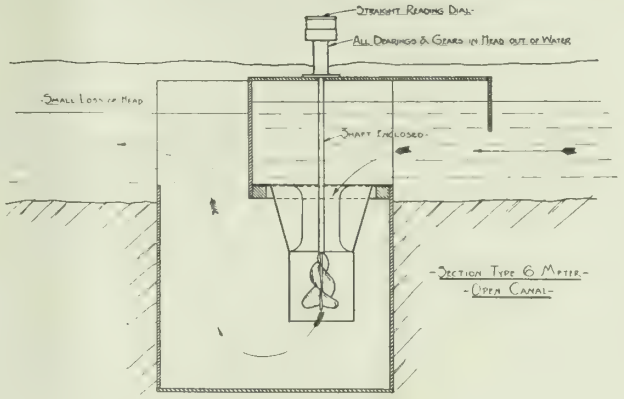
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WITH THE WATER COMPANIES

Of Interest Expressly to Water Works Engineers, Superintendents and General Managers

California Public Utility Water Systems Now Number 500

Year 1924-25 Sees Increase in Spite of Many Consolidations; 1924 Was Difficult Year

Public utility water systems in California increased during the fiscal year ending June 30, 1925, from 450 to 500, despite the fact that there were many consolidations of private systems and a large number were taken over by municipalities, according to the recent report of the Hydraulic Division of the Department of Engineering of the Railroad Commission.

During the last fiscal year the Commission rendered 134 decisions involving water utilities, which were investigated and reported on by the Hydraulic Division. In addition to these, 46 decisions were rendered by the Commission relating to security issues of water companies.

Due to the efforts of the Hydraulic Division the operation of water utilities was conducted during the serious drought of last summer with a minimum of damage and loss to both property owners and the water companies.

Although the rainfall last winter was not up to normal in the southern part of the state, conditions are much improved this year. Conditions north of the Tehachapi are much improved, and pro rating of the use of water will not be required in this section of the state so extensively as may be required in the territory south of the Tehachapi, says the report.

Valuations and rate proceedings involving valuations of public utility water property to the amount of $5,142,497.00 were handled by the Hydraulic Division during the last fiscal year. Informal complaints involving water utilities to the number of 784 were handled by the Commission during the fiscal year. These involved 153 field investigations.

The Hydraulic Division also investigated plans and checked the work for the following important dam construction projects: Lake Almanor dam of Great Western Power Company; Florence Lake Multiple Arch Dam of Southern California Edison Company; concrete arch dam on James Creek for Central Mendocino County Power Company; concrete arch dam on Klamath River for California-Oregon Power Company; hydraulic filled dam on San Leandro Creek for East Bay Water Company; concrete dam on Pit River Development No. 3 for Mt. Shasta Power Corporation, a division of Pacific Gas and Electric Company.

Water Works Engineers to Meet at Santa Cruz

California Section of American Water Works Association Convenes for Three-Day Session October 15

October 15, 16 and 17 will see the water works engineers of California in session in the annual convention of the California Section of the American Water Works Association. This year the meetings are to be held in the Casa Del Rey Hotel, Santa Cruz.

The California chapter of the American Association now has a membership of about 125, a large percentage of whom are expected to be present at the October sessions.

There will be more space for exhibits than has been obtainable in past years, and the Exhibitors Committee, under the chairmanship of R. W. Martindale, has sent out invitations to a selected group of manufacturers who will be accorded the privilege setting up exhibits of an educational nature for the inspection of the engineers.

George W. Pracy is President of the California Section; C. B. Jackson, vice president; and S. B. Morris, secretary; with P. Diederich and John Burt as the two additional members of the Executive Committee.

Stock Issue Authorized

The Santa Paula Water Works has been authorized by the California Railroad Commission to issue, at not less than par, $123,200 face value of unsecured promissory notes, payable at not more than three years after date, with interest at not exceeding seven per cent per annum, for the purpose of paying notes now outstanding.

New York Looks Ahead to 7,000,000 Population

Water Problems of a Decade Hence Are Causing Grave Concern to Nation's Metropolis

That the question of future water supply is not merely a problem of the west, but of many districts of the east as well, especially in relation to an assured continuance of adequate supplies for domestic and industrial uses in the great metropolitan centers, is indicated by the questionings that are shaking the heart of New York City, which is looking forward to a population of seven million within a decade, and wonders where the water is coming from.

The present provisions which the city has made to protect itself against any possible water famine will last, says the *Scientific American,* in a recent number, at the present rate of population increase, until the year 1935, "but at that time the use of water will exceed the safe yield of the then existing sources of supply. A conservative estimate by the Board of Water Supply places the population of this city ten years from now at 7,600,000 people. The rate of consumption is 135 gallons per capita per day; it is slightly increasing.

"Prudence demands that the city at once take preliminary steps to secure a water supply additional to the 1,036,000,000 gallons now available. New sources of supply of excellent drinking water can be provided on the west side of the Hudson by raising another dam on the lower Schoharie and by the development of Catskill Creek. This would provide an additional 500,000,000 gallons per day; and a development of the streams in Dutchess, Columbia and Rensselaer Counties on the east side of the river, would yield another 350,000,000 gallons.

"When the city has grown to the extent predicted, it must fall back upon the great catchment basin of the Delaware River. An equitable apportionment of the waters of this great river is being sought in a compact between the three states concerned, by which New York will be assured of 1,500,000 gallons per day of water of the same quality

as that of the Catskill system. New Jersey will secure the same quantity, and Pennsylvania will have at its disposal 3,000,000,000 gallons, which it can use at such time and in such quantities as its various cities may require. The compact merely defines the rights of the states and it should receive the unanimous support of the three legislatures concerned."

Palo Verde Bonds Voted

A special election called by the Palo Verde, California, Irrigation District, on the issuance of $3,287,000 in bonds, was held late in August and resulted in an overwhelming victory for the proposition.

The bonds will be issued to provide funds for the acquisition of water rights and system of the Palo Verde Mutual Water Company, to pay outstanding bonds, for the strengthening and extending of present levees along the Colorado River and for other protection work, and for the purpose of enlarging the water distributing system, constructing drainage canals, nad necessary surveys.

The bonds will be in three issues, installments being due from 1937 to 1955.

Balloting was on the basis of assessed valuation of real estate and improvements, included in the irrigation district, one vote being allowed for each $100 assessed valuation or fraction thereof greater than $50. Large holdings were totaled, and the assessed valuation divided by 100, the resulting quotient being the number of votes cast by such individual or company.

The Palo Verde Irrigation District was formed by the consolidation of the Palo Verde Joint Levee District, the Palo Verde Mutual Water Company, and the Palo Verde Drainage District, under a special act of the California state legislature, passed June 21, 1923. This legislation act also made provision for the special plan of voting which was followed.

Company Faces Problems

Water companies of Banning and Hemet, Calif., are faced with difficult problems as the consequence of a long "dry year." The Banning Water Company is operating four pumping wells, and is cleaning and deepening the big well at the Bigley Canyon gate. The wells are electrically operated. The heads of water available are much smaller than for previous years. Many new wells have been sunk in the Hemet district, lifting the water 200-300 feet in many cases.

Bissell Writes on Forest Problems

(Continued from Page 19)

If it matters, let some one else put the fire out. If it must be protected, let the Forest Service do it—that is what they are for! As long as this attitude is held by a large part of the people the situation is well nigh hopeless. They must be made to see and to know.

FORTUNATELY, some of us in the State of California, are alive to the necessity and have formed an organization whose object is the conservation of our forest resources—The Conservation Association of Southern California. It is a clearing house through which all constructive effort can be cleared. The most serious and pressing problem that faces Southern California today, and one which other parts of the west are meeting in one form or another, is a more adequate and dependable supply of water and the protection of our valleys from floods. Problems of such magnitude can only be solved by the united effort of all classes of interests. They are the problems of the rancher, the business man and citizens at large. Our growth and permanence will be in direct ratio to our success in their solution.

It is indeed strange that up to this time a subject that so directly affects not only our prosperity, but our very existence, has received only the sporadic attention of uncorrelated groups.

Due to this lack of united and sustained effort, our mountain watershed is being destroyed acre by acre and year by year. The Conservation Association of Southern California is the result of three or four years of cumulative effort and combination, until now most of the constructive thought along this line is directed through one channel.

A foundation is being laid on basic lines, the results of which will become more and more tangible and concrete as the organization grows in members and in strength. This Association invites the co-operation of Chambers of Commerce, business organizations, municipalities, service clubs and all organizations and individuals that believe that all agencies and interests have a common ground and can work together on a program of basic principles on which we can stand united. When this is achieved, success is assured.

Commission Grants Extension

The California Railroad Commission has granted an extension of time until December 31, 1925, within which Ed Fletcher may sell the Cuyamaca Water Company to the La Mesa, Lemon Grove and Spring Valley Irrigation District, located in San Diego county.

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WHO'S *WHO* AND WHO'S *WHERE*

IN IRRIGATION AND RECLAMATION

Personal Notes and Impersonal Observations About Men You Know

W. O. Blair, director of the Imperial Irrigation District, and A. L. Graves, master mechanic, have been authorized by the district to make a trip to the east for the purchase of machinery for the Imperial District's shops.

J. R. Mason and J. D. Neale, of San Francisco, of the J. R. Mason Company, irrigation security specialists, were members of a party of prominent irrigationists who inspected the Tumalo irrigation project during August.

Hervey Lindley, of Seattle, was reelected as president of the Columbia Basin Irrigation League at the recent meeting of its Board of Directors. Francis M. Goodwin, of Seattle, formerly assistant Secretary of the Interior, was chosen as the Washington (D. C.) representative of the league.

H. A. Van Norman, formerly city engineer of Los Angeles, resigned that office during August to become assistant general manager of the city water department, as assistant to William Mulholland. John C. Shaw was appointed city engineer succeeding Mr. Van Norman.

M. J. Dowd, recently appointed general manager of the Imperial Irrigation District, has been named general manager for the Compania de Terrenos y Agua de la Baja California. This appointment as managing head of the Mexican company enables the Imperial executive to take control of the district's interests below the Mexican border.

J. E. Haley, Jr., of the California state engineer's office, made a recent trip of inspection to the Imperial Valley for the purpose of examining the accounting system in use by the Imperial Irrigation District. The state engineering department is interested in the system, says Mr. Haley, and is considering recommending its adoption by other irrigation districts of the state.

O. E. Meinzer, chief of the ground water division of the United States Geological Survey, is in southern California after three months spent in Arizona and along the Colorado River. Mr. Meinzer will make water surveys in the southern California region, notably at Camp Kearney, near San Diego, where the government is said to be contemplating the establishment of an air base.

Mrs. Nellie Taylor Ross, Governor of Wyoming; Clarence J. Morely, Governor of Colorado; and George Dern, Governor of Utah, meeting in a two-day conference late in August, issued a statement calling on representatives of those three states in Congress to oppose any development of the Colorado River by lower basin states until the rights of the upper-basin states had been fully protected.

Governor Pierce of Oregon and members of the state securities commission were recently the guests of directors of the Tumalo Irrigation District, on an official visit made to determine whether the state will guarantee interest on the Tumalo irrigation district bonds for the next two years. Directors of the district are E. M. Wright, C. H. Hatch, and W. R. Gerkins. D. J. McClelland is project manager.

Boulder canyon and the Swing-Johnson bill will probably be a vital issue of the forthcoming campaign for United States senator from California. Robert M. Clarke, president of the California Bar Association and senatorial candidate, speaking at a Labor Day Celebration at Los Angeles, opened his campaign with a vigorous statement championing the Swing-Johnson measure and the All-American canal.

E. E. Blake, chairman of the Irrigation Commission of Oklahoma, A. S. Stinett, Irrigation Commissioner of Texas, A. Lincoln Fellowes, engineer of the Department of Agriculture, with R. J. Freeland, J. A. Dykes, and Albert Calisch, Irrigation Commissioners of New Mexico, in a conference at Tucumcari, N. M., in August, discussed irrigation developments of mutual interest to the three states. The party of irrigation officials made a trip of inspection of various dam sites along the Canadian River in New Mexico.

R. A. Thompson, of the firm of Nagle & Thompson, consulting engineers, of Dallas, Texas, has recently formed a consulting partnership with H. G. Butler, former Power Administrator for California, with offices at 216 Pine Street, San Francisco. Mr. Thompson was formerly chief engineer of the California Railroad Commission. Nagle & Thompson, with whom he is associated in Dallas, are the engineers in charge of the construction of the $3,500,000 Garza Dam for the city of Dallas.

A. L. Sonderegger, well known engineer of Los Angeles, has been named by Riverside County as its representative on a board of three experts, representing Riverside, Orange and San Bernardino Counteis, respectively, in a survey of the Santa Ana River and to advise with the office of the state engineer of California in the determination of work to be done for the conservation of its water supply. George Hinckly, of Redlands, representing San Bernardino County, and J. B. Lippincott, Los Angeles, representing Orange County, are the other two members of the committee.

Senators and Congressmen of Oregon, with state officials and prominent irrigationists of the state, were guests of honor at a Congressional Banquet held in August at Madras, Oregon. Senators Robert N. Stanfield and Charles L. McNary, Oregon's representatives in the United States senate, and M. E. Crumpacker, N. J. Sinnott, W. C. Hawley, and Denton G. Burdick, members of the House of Representatives, were among the speakers. Rhea Luper, state engineer, and H. M. Chadwick, assistant, gave short talks. Dedication to the development of Oregon through irrigation was the dominant note of the banquet.

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RECLAMATION

A DEDICATION TO A BROAD POLICY OF CONSERVATION

By HUBERT WORK

Secretary, U. S. Department of the Interior

HUBERT WORK is the official head of that department of the government most directly concerned with irrigation, and as such, is listened to with interest, if not with uniform approval, whenever he declares the policy of his department with relation to reclamation and conservation. The accompanying article is a reproduction, in part, of his address at the recent celebration at American Falls, Idaho, when construction was begun on the great American Falls Reservoir.

FOR three centuries we have been an exploiting people. We have seized on the great natural resources of the country and put them to individual use which was too often wasteful and destructive. This has created a kind of thinking and a kind of organization which makes it difficult for people to realize the necessity or importance of organizing our future development along the lines of permanence or economy.

Economy is simply a factor in the larger question of conservation. Necessity is the mother of invention, and new conditions call for new remedies. As a people and a nation we have completed an epoch of free utilization of our natural resources, but we now stand on the threshold of a new era which, if we are to adapt ourselves to future conditions, makes it necessary for us to direct our thoughts and acts toward thrift.

FIFTEEN years ago the country was disturbed by a wordy war between extremists, discussing conservation. The line of dissension was drawn between those in the East which had already cut its timber, had seen the rapid depletion of its limited oil deposits and was abandoning exhausted farms and those in the West, where the land's fertility had been demonstrated, where the great forests were yet untouchd and the mineral deposits were described as inexhaustible.

The East sought to lock up through legislation the wealth of the West for use of succeeding generations. The pioneer, believing that the richness of the West was his by right of discovery, and access to it had been earned by the hardships incident to developing a new country, resented what he called strong armed action of the majority of numbers.

Policies were used to propagate personal attacks among administrators, and bitterness developed between employees of different Departments of the Government that only within the last four years has begun to subside.

ALL OF THIS was unfortunate and wholly unnecessary. Like a forest fire it swept the West but left smoldering embers easily fanned into flames of reprisal and ever since has affected the political destiny of many men.

A line of divergence or dissociation of interests between the East and the West, or the North and the South, in these United States is no longer tolerable. All points have a common responsibility, a common interest in ultimate results, and a diversity of resources for common use.

The conservation of the soil's fertility is vital to life. It produces our food, but the conservation of every incidental to the whole scheme of living should be associated. The most pressing study of the Government, and one in which I know the greatest minds in this country could be enlisted, is this larger conception of conservation. While it is too big for any one branch of the Government alone, to develop in its fullness in time to meeting pressing exigencies, nevertheless it should have centralized Departmental authority. The Government would then have a correlating nucleus for forming about it wealthy men who now stand ready to help, an organized movement to accomplish something worth while of national scope looking into the future, in the interests of those who are to follow us.

The farmer's place in conservation is fundamental, for all branches of human industry eventually trace back to the farm. No other single product compares in value to the farm crop. Older nations have gone blindly on and exhausted their soils of that inherent fertility, stored up through millions of years of sunshine, rains and decaying vegetation. Now their soil serves only as a base and must be fed each year with its food to produce human food, the sun and rain and labor supplementing the fertilizer in the soil. The same processes are being adopted in the Eastern United States. The West has this priceless inherent asset of the soil and should preserve it, for it is fundamental to its moral, social, and economic integrity.

The new conservation idea means intelligently utilizing what we have rather than abandoning it for new resources. Through the wanton destruction of bird life, scientists tell us we have multiplied insect life by millions of folds; we are told that last year American farmers lost eight hundred millions of dollars by insects. This damage to crops by insects in a single year exceeds any possible inroad by the hand of man on our national resources during a like period and is far greater than the cost of all the reclamation projects in the United States. The chestnut bark disease, first noted near New York City in 1904, quickly extended its blight over large areas and brought destruction to a profitable product of the forests. Storms, frost, and other natural phenomena also take their toll from the American farmer.

SOME of these enemies of conservation which exemplify Nature's continuous process of waste and repair will eventually yield to scientific agriculture, but in the meantime we must study to overcome loss from causes we can understand.

Through the process of artificial selection we have increased the value of vegetables and even produced new types. We use and at the same time conserve our domestic animals through pure bred

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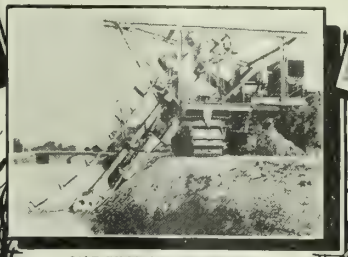

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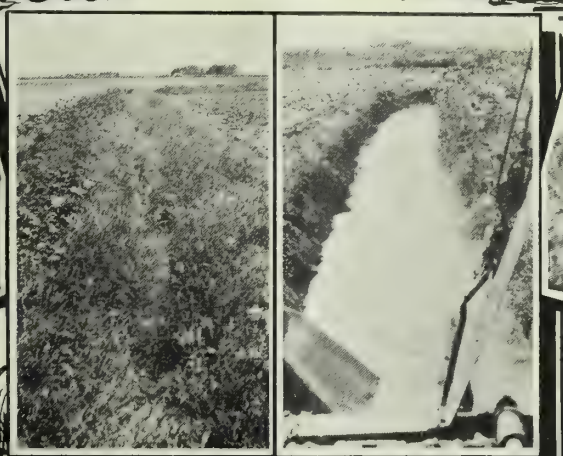

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YUMA, ARIZONA

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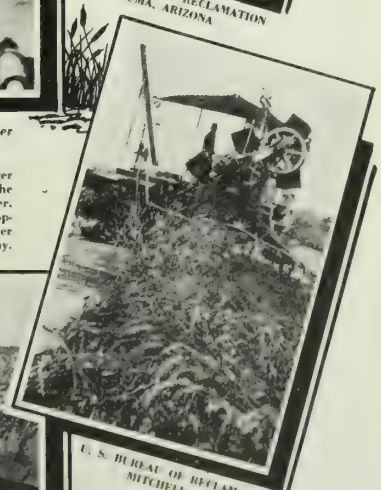

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MITCHELL, NEB.

Here Are Pictures Showing What The Ruth Super Crawler Dredger Actually Does

The picture on the left above shows conditions that the usual dredger cannot hope to cope with, at Mitchell, Nebraska. The upper picture on the right shows the clean-cut ditch made by The Ruth Super Crawler Dredger. You will note in the picture the Ruth is still going through without any stoppage by growths of any kind, and it will be readily seen The Ruth Super Crawler Dredger works equally well in water as in dry earth, 'dobe or clay.

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sires; we ingraft fecund branches on sturdy trunks that have become exhausted from age and long bearing; we diversify our crops to rest the land and raise crops to plow under to feed the soil. We have been working to increase the total yield rather than to improve the quality of the crop. The exacting demands of the consumer will in time correct this.

People, like animals, are found in greatest numbers where food is easiest to obtain. They, too, are gregarious. Our rapidly growing population and citizenship must be provided for in advance. We should locate its necessities and conserve that which cannot be reproduced. It is said that 38,000,000 acres more will be needed for crops in 1955, with no increase in our imports, to feed the normal increased population.

Exhaustion of the soil's fertility was not stressed in the conservation policy of the past. It advised the cutting of the ripe timber which destroyed much that was growing. It compelled drilling for oil if a neighbor found it, and did not warn against exhausting the soil by tenantry which treatens to cover the West, like the East, with abandoned farms and make of us a manufacturing, rather than an agricultural people, and in some old States has made impossible the growing of sturdy children on farms. It takes 90 days to grow a crop of corn, 21 years to grow a crop of children, and a hundred years to grow a forest. One million boys and one million girls reach 21 years annually. The growing of these young people is a national responsibility. Their education is of importance, but their intelligence is vital to the safety of this nation.

WE CANNOT regard Federal Reclamation as of local importance only. Whether this semi-arid region shall continue to support itself, our Western coast, and load their ships outbound, or revert to sparsely settled range conditions, to be fed by the Middle West, is a national question and an outstanding feature of conservation, as the country must be made to understand it, to be secure in its position as supreme among nations.

Our reclamation projects, which are of engrossing concern to me, have 6,609 unoccupied farms of varying size, or 564,000 acres. More than 14,000 potential farms of 40 acres each. How we can put farmers on this land who will produce foodstuffs in lieu of what we are importing is our big problem.

We are consulting Western Representatives in Congress, Governors of States, and editors. The latter have the keenest and at the same time the most independent judgment on local situations, and we travel with railroad managers whenever possible, the purpose being to enlist all of them in this common cause. Our older reclamation projects are being mined of their fertility by tenants, precisely as the East has been. Why not at least preserve this virgin fertility as an inducement, to get and hold people on these projects and to build up thoroughly American communities? The United States last year imported about $425,000,000 worth of crude foodstuffs and food animals, exclusive of wool and cotton. *It is idle to change our production of farm products and limit them to compel higher prices until we are producing more than we consume.*

But back of it all is the greater question of conserving the American people. We should not exploit men and women to open up new regions. We can not exhaust natural sources of food supply and weaken the race. We can not pass on blindly to a point where one season's drought would put a prosperous nation in want. The fertility of our soil must be conserved or restored when lost, or our boasted civilization will fail. When the lime has left the land and has been deposited in men's arteries, the end is not far off. We are in time to forfend this situation. The hope of our country is in the virile Americanism of the West, in its people, its soil, its minerals, and in its vision.

What the Imperial Irrigation District Is Trying to Do

(Continued from Page 13)

and out of the shop and current work was being taken care of promptly. I have reduced the shop force from 69 men to 41 men on August 1, 1925, and am finding no difficulty in keeping pace with the work."

In September, 1924, the District Board re-established a $5.00 assessment rate, notwithstanding the fact that the chief engineer brought in a proposed budget that would have required nearly $2.00 per acre added assessment. He was instructed to revise his estimates and to eliminate several items held to be unnecessary at this time. The Board held that it is better to reduce expenditures to a minimum than to attempt to burden the tax payers with added assessments at this time.

With more than half the present year over, the judgment of the Board has been found sound, and the entire District organization is working in closer harmony than ever before with a greater degree of efficiency, and well within the revised budget.

IN OUTLINE the system now being worked out calls for a general superintendent, responsible directly to the Board of Directors; a purchasing agent, responsible to the Board and having complete charge of all purchases; a master-mechanic, responsible to the Board; and division superintendents over each division.

The purchasing agent has been instructed to reduce the stock heretofore carried in great quantities, to a minimum. He is required to keep accurate check of all materials at all times.

The master mechanic is instructed to handle all repair work on machinery rather than send it to outside shops. He has already made some remarkable savings in that way.

In short, the Directors are in the act of putting the District on a thoroughly business-like basis, with the responsibilities of each department fixed definitely and the functions of each specifically outlined.

With more than 2,000 miles of canals and laterals, with a $2,500,000 drainage system now practically complete, and with a payroll of approximately 1,200 employees, there must be some careful planning, and the laws of the state of California have made it the duty of the District Board to do that planning. The fact that the source of the water supply of the Imperial Valley happens to be the Colorado River, and that the intake canal now runs for nearly 60 miles through Mexico before it delivers water to the District, coupled with the fact that this same Colorado River is the object of a great scramble among a number of private and state and national interests, has for the moment thrown the spotlight of publicity upon the Imperial Irrigation District administration so that reports of every conceivable nature are sent out; but that does not alter the duties of the Board of Directors of this District. By his oath of office, every Director is pledged to secure the District's supply of water, maintain the system and protect the assessment payer. If the carrying out of that obligation requires the Board to deal with foreign governments, national and state governments, that is an incident. If the Board finds that the best interests of the District require a reorganization move to cut down costs, that is an incident. The duties of the Directors are plain, and they must be fulfilled without regard for personal feelings or special interests.

Carberry's Dismissal Evokes Interesting Comment

Imperial District's Action Brings Letter from State Engineer Urging Adequate "Technical Assistance"

Interest has been aroused throughout the irrigation country by the action of the Board of Directors of the Imperial Irrigation District in requesting the resignation of Ray S. Carberry, chief engineer. The board's own explanation of its action was that the office of chief engineer might well be abolished in the interests of "economy", but observers who are unsympathetic to the board have interpreted it in various ways.

An official comment on Mr. Carberry's resignation was made by W. F. McClure, State Engineer of California, writing as a representative of the Bond Certification Commission, in a letter addressed to the Directors, with which was enclosed a copy of a letter written by him to Mr. Carberry.

The two letters follow:

Board of Directors,
Imperial Irrigation District,
Calexico, California.
Subject: Chief Engineer.
Dear Sirs:

I regret to learn, through a letter from Mr. Carberry, that his services are to be dispensed with beginning August 1st, and please take this as an expression from the Bond Certification Commission that we shall expect your splendid project to employ such technical assistance as is commensurate with the various and intricate problems presented in the matter of serving Imperial Valley with irrigating water.

Enclosed herewith copy of letter going to Mr. Carberry.

Very truly yours,
(Signed) W. F. McCLURE,
State Engineer.

To Mr. Carberry, Mr. McClure wrote:

Dear Mr. Carberry:

Am just in possession of yours of July 28th, together with copy of resolution adopted by the Board of Directors of the Imperial Irrigation District on July 23rd, requesting your resignation as Chief Engineer of the District.

Also have copy of communication addressed to yourself by Mr. McIver, Secretary of the District. setting forth the judgment of the Board of Directors that in its judgment it is "for the best interests of this District to abolish the office of Chief Engineer."

I do not know your successor nor what the Board of Directors may have in mind other than their claim for economy, but I speak for the California Bond Certification Commission when I state that if the Board employs a man with a lack of technical ability such as you possess it will make a mistake and the District will suffer.

Thank you kindly for expressions of appreciation of the consideration given you from this office and permit me here to state that such expressions are heartily reciprocated as we have always been graciously received by yourself and associates and every request lodged with you has been cheerfully and promptly acceded to.

May your future be bright!

W. F. McCLURE,
State Engineer.

Wyoming Leads in Sale of Public Lands

Federal Reclamation Fund Increased $158,429.53 In First Quarter Ended June 30, 1925

The Reclamation Fund of the federal government was increased $158,429.53 through receipts from the sale of public lands including fees and commissions for the quarter ended June 30, 1925, the Interior Department has announced.

The largest receipts for the fund came from the State of Wyoming, the amount being $22,916.06. The second largest receipts were from California, with $22,500.79, while the third were from New Mexico, with $19,756.41. The State with the smallest receipts was Kansas, with $34.24. A list of the States with proceeds from the sale of public lands credited to the Reclamation Fund follows:

Arizona	$12,025.49
California	22,500.79
Colorado	17,889.11
Idaho	9,923.88
Kansas	34.24
Montana	13,489.40
Nebraska	4,668.12
Nevada	5,917.21
New Mexico	19,756.41
North Dakota	581.27
Oklahoma	1,024.74
Oregon	12,501.45
South Dakota	2,559.81
Utah	8,178.19
Washington	4,463.36
Wyoming	22,916.06

The terms of the Reclamation law passed in 1902 provide that a part of the proceeds from the sale of public lands shall be credited to the Reclamation Fund for the construction and maintenance of irrigation projects by the Government.

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IRRIGATION FINANCE

HOW THE IRRIGATION LAW PROTECTS THE BOND-HOLDER

By S. M. HASKINS

THE RAPID expansion of the irrigation area in California during the last decade has been made possible through the organization of Irrigation Districts under the State Law, commonly known as the "Wright Act." Originally passed in 1887, this Act has gone through an evolutionary process of improvement. Each succeeding legislature has passed amendments of more or less importance. The fundamental objections to the Act were not overcome until 1897. Radical changes were made at that time in the procedure for organizing the districts and the incurring of district indebtedness.

As expressed in its title, the California Irrigation District Act, as it is now called, is an Act to provide for the organization and government of irrigation districts, and to provide for the acquisition and construction thereby of works for the irrigation of the lands embraced within such districts, and, also, to provide for the distribution of water for irrigation purposes.

A California Irrigation District is a political subdivision of the State, quasi-municipal in character, with power to irrigate and drain lands in the District, and to develop and distribute hydro-electric power.

In California at the present time there are about ninety-six active irrigation districts of the type under consideration. These districts comprise an area of 4,000,000 acres. This is about two-thirds of the entire area under irrigation in California. The great bulk of this development has occurred since provisions were made by state law for state supervision in organization, construction and financing of the projects.

THESE irrigation districts are organized in much the same manner as school and all special assessment districts. In the matter of organization, the law has placed the following safeguards:

1. The districts are organized upon petition of a majority in title representing a majority in value of the landholders within the area of the contemplated district. Or there is an optional plan of a petition by five hundred electors or landholders within any contemplated district, providing these five hundred petitioners represent twenty per cent of the value of the land within the proposed district.

2. The Board of Supervisors of the County wherein the district is located refers the matter to the State Engineer, who through the State Department of Public Works passes upon the feasibility of the entire project.

THE California Irrigation District Act, popularly referred to as the Wright Act, is a constructive piece of legislation that has meant much to irrigation in California. The accompanying article will be of interest not only to investors and potential investors in the irrigation securities of that state, but also to irrigationists in those parts of the west not so favorably situated in regard to state legislation designed to encourage irrigation. Mr. Haskins, who has written this discussion, is a member of the legal firm of Gibson, Dunn and Crutcher, Los Angeles.

IN THE MATTER of the issuance of bonds, the interests of the bondholders are further safeguarded as follows:

1. By a special act of the California Legislature there has been created a Bond Certificate Commission, composed of the Superintendent of Banks, the State Engineer, and the Attorney General. It is the duty of this Commission to pass upon all bond issues submitted to them for certification as legal investments for banks and insurance companies, and as security for public deposits. At the request of this Commission the State Controller will certify irrigation district bonds as legal investments for all trust funds, and for the funds of all insurance companies, banks, both commercial and savings, and trust companies, and as security for public money deposits. If bonds are so certified, the law places further safeguards:

(a) No expenditure shall be made by the district without the schedule for the same being approved by the Commission.

(b) During the progress of any work to be paid for from the proceeds of any bond issue certified by the Commission, the Department of Engineering on behalf of the Commission shall make from time to time, at the expense of the district, such inspection of the work as may be necessary to enable said Department to know that the plans approved by the Commission are being carried out with no material modification.

2. The Act creating this Bond Certification Commission also places a practical *debt* limit on irrigation districts. Before certifying, the Commission passes upon the supply of water, nature of the soil, including its fertility, as well as the feasibility of the project. But in addition it ascertains a reasonable market value of the water, water rights, canals, reservoirs, etc., as well as the market value of the land within the district. Now if the aggregate amount of the bonds, including those to be issued, does not exceed *sixty per cent* of the aggregate market value of the lands within said district and of the water, water rights, canals, reservoirs and irrigation works, the bonds are eligible and may be certified. From the above it is evident that no irrigation bond can be certified as a legal investment or security for public deposits if the debt of the district exceeds sixty per cent of the value of the district and its irrigation system.

3. The law in dealing with the question of the bond election specifically states that no information in conducting such an election shall invalidate the same if the election shall have been otherwise fairly conducted. By court interpreta-

tion this would no doubt apply throughout the Act as representing the spirit in which the Act was framed and would seem to remove the hazard of illegality.

4. In the estimate of the amount of money necessary to be raised by the first issue of bonds of any district, the Board of Directors may include a sum sufficient to pay the interest on all of such bonds for three years or less. With municipal bonds, taxation is the machinery through which the bondholder receives his principal and interest. It is, therefore, important that we analyze the provisions of the Act in this respect. All the expenses of the district, including the interest and principal of the bonds, are paid by the levying of assessments on the land in the district. Such assessment is not against benefits, but is an ad valorem tax. These bonds are general district obligations, no land in the district can be released from the lien thereof until the last bond has been paid in principal and interest. Improvements on any lands or town lots within such districts shall be exempt from taxation for any of the purposes mentioned in the Act. The Board of Directors sits as a Board of Equalization. Directors may at their discretion add one per cent of the total assessed value to the assessment for sinking fund purposes, or to be used in retiring bonds.

THE LAW specifically takes care of any failure on the part of the public officials to perform their duties by providing that if the Board of Directors of the district refuses or neglects to make such an assessment and levy, then the duly equalized assessment made by the County Assessor of the county within which the district is located shall be made the basis of the assessment of the district. And the law further provides that the Board of Supervisors of the county *shall* cause an assessment roll of the district to be prepared. In other words, if the Board of Directors does not act in preparing the assessment roll and levying the assessment, the Board of Supervisors must step in and perform the duties of the Board of Directors.

In case the Collector or Treasurer of any district refuses to perform the duties imposed upon him by the law, then the County Tax Collector and the County Treasurer *must* perform such duties and shall be accountable under their official bond for so doing.

The law also recites the specific duties of the District Attorney of the county in such cases of non-performance of duty. It shall be the duty of the District Attorney of each county in which the district is located to ascertain whether or not such duties are being performed. If the Board of Directors or any official has neglected or refused to perform any of the duties in question, the District Attorney must notify the County Board of Supervisors, or the other county officials concerned, or both. Unless the Board of Supervisors or the County official proceeds within thirty days to the performance of these duties, the District Attorney *shall* take whatever action in court may be necessary to compel performance. In the event that the District Attorney fails to do this, the law provides that the Attorney General of the State will take such measures as may be necessary to enforce the performance of the duties relating to the levying and collection of assessments as in this Act provided.

A writ of mandamus will also lie against the Attorney General and other officials to compel the performance of their duties as placed upon them by law.

Because of these remedies in the event of the failure of the officials to act, the law is much stronger and better in the case of irrigation district bonds than it is in general county and city municipal obligations.

However, an assessment made must be paid and our next task is to ascertain the remedies the law provides in case of failure to collect this assessment. The assessment upon the land is a lien against the property assessed, from and after the first Monday in March for any year. Assessments become delinquent at six o'clock on the last Monday of December, and, unless paid, ten per cent is added to the amount thereof.

On or before the first day of February, the Collector must publish the delinquent list. The publication must designate the time and place of sale. The time of sale must not be less than 21 nor more than 28 days from the first publication of the delinquent list. The property is sold for the amount of the delinquent taxes and charges, including penalties. The title so acquired is subject to the right of redemption, but with this contingency the title may be conveyed by deed. A certificate of sale is made out at these tax sales and filed with the County Recorder and after such filing the lien of the assessments vests with the purchaser and is only divested by the payment to him, or to the Collector, for his use, of the purchase money and two per cent per month from the day of sale until redemption.

REDEMPTION of the property sold may be made by the owner or any party interested within three years from the date of purchase, or at any time thereafter before the final deed has been made and delivered. If the property is not redeemed within the time

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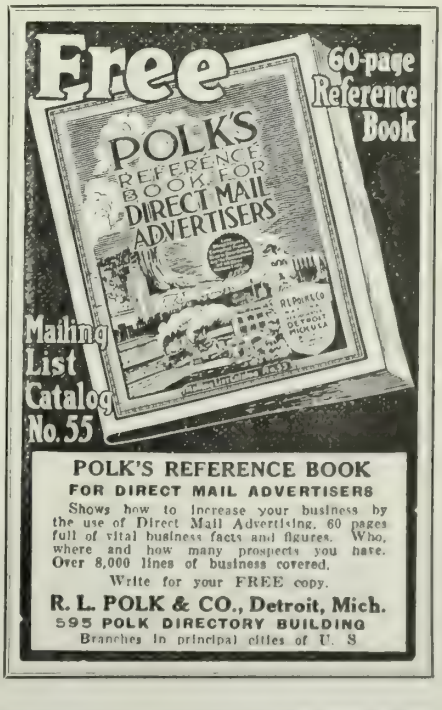

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herein provided, the Collector upon demand must make to the purchaser or his assignee, a deed to the property. Such deed conveys to the grantee the absolute title to the lands.

The Board of Directors may, at any time after any assessment has become delinquent, direct the Collector not to proceed with the sale of any property, but to bring suit against the delinquent taxpayer in the proper court in the name of the district and enforce collection.

The provisions of this section would seem to give a double remedy in the case of financially responsible persons. In other words, the land may either be sold for taxes or recovery of the taxes made by direct suit.

Irrigation bonds are not subject to any California State Tax and not to any Federal Income Tax. Individuals are not required to declare ownership to the Federal Government.

This completes an explanation of those sections which vitally affect the safety of the bonds of these districts. It seems that all necessary legal safeguards have been thrown around such obligations and that under the workings of the law these bonds are safe as the future of the land against which they are a lien. The failure to realize from the bonds would mean that all the property within the district could not be liquidated for the amount of the bond issue. This is the implication from the act. If the bondholder has satisfied himself as to the value of the district up to the amount of bonds issued, he need have no fear as to the ultimate payment of his obligation.

Prominent Irrigationists Serve on Board of Editorial Advisors

(Continued from Page 14)

position with the Commonwealth Power Company, now the Consumers Power Company, his first work with that company being in the construction of its first hydro-electric plant on the Kalamazoo River.

He located in Ontario, California, expecting to devote his time to the growing of oranges, but in 1908 became connected as a director with the San Antonio Water Company and the Ontario Power Company, and in 1909 took the general managership of these two companies.

He has been very active in the development, conservation and use of water for irrigation, and when the California Mutual Water Companies' Association was formed in 1918, he became its president and has been continued in that office since then.

He conceived and constructed for the Ontario Power Company the first combination remote and automatic control hydro-electric plant built, and this type of plant has become standard practice for small powers.

GEORGE L. SWENDSEN is chief engineer and general manager of the Fresno Irrigation District, California. Mr. Swendsen is a typical representative of the successful irrigation business man. "The business features of irrigation projects have always seemed to me more important than the construction details," he says. "The executive matters are the affairs in irrigation which challenge my interest."

Mr. Swendsen was graduated from Harvard University with a B. S. degree in Civil Engineering in 1894. Since 1902 his entire career has been devoted to irrigation and hydraulic developments in Idaho, Utah and California.

From 1903 to 1906 he was U. S. Reclamation Service District Engineer for Utah and Southeastern Idaho. From 1906 to 1917 he was connected with the construction and development of irrigation and power projects on Bear River, Snake River and Weiser River in Idaho. In these years he gained a broad knowledge of the construction, management and business features of such projects, which has served him admirably in his later experience.

Coming to California in 1917, he was engaged for three years, until August, 1920, building and operating the Boston Land Company's Project of 35,000 acres in the San Joaquin Valley, served by deep well pumps and an elaborate concrete pipe system. In this project also Mr. Swendsen had business features in his direct charge on behalf of the investors.

Since August, 1920, he has been chief engineer and manager of the Fresno Irrigation District, a district which includes 243,000 acres, with 10,200 water users.

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These, therefore, are two *distinct* advantages to be gained through long-pull advertising now. Would you like to know about still other advantages, including information as to rates, circulation, etc.? If so, it's a simple matter to write a note or a telegram of inquiry. No obligation whatever is involved.

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OVERHEAD IRRIGATION

OVERHEAD IRRIGATION FAVORED FOR AVOCADOS

By J. ELIOT COIT

IT IS MY experience that overhead irrigation is particularly well suited to avocados. It is commonly accepted that the amount of water required for avocados is about the same as for Citrus, but the interval is less on most soil types, and much less on sandy soils. For best results on light sandy soils, avocados should receive a light watering every ten days during midsummer. It is simpler and involves less labor to give frequent light waterings with the overhead.

In the second place, the avocado differs from most other orchard trees by being well adapted to the permanent mulch system, with no tillage after the trees come into full bearing. Such a system is impracticable, or at least very difficult, with furrow irrigation.

Compared with citrus or other orchard fruits, the avocado yields a much higher gross return per acre, thus warranting the additional expense of installing equipment for irrigation by overhead sprinkling.

Avocado Orchard and Nursery Receiving Overhead Irrigation on Rancho Sencadia, Encinitas, California. Dr. Coit, in the Accompanying Article, Enthusiastically Recommends the Overhead Method for this Fruit

IN PROPAGATING avocado trees in the nursery, it is necessary to plant the seeds on the surface of the soil with the apex of the seed exposed. The seeds must be kept continuously moist, and as this is practically impossible by furrow irrigation, nurserymen have adopted the policy of planting the seeds in beds where they can be sprayed by hand with a hose. The seedlings are later transplanted to nursery rows with consequent checking of growth, loss of time, and increase in labor. For two seasons past I have planted the seeds directly in the permanent nursery rows and irrigated with the overhead at frequent intervals. The result has been an almost perfect stand of vigorous seedlings and a three or four months shortening of the time from seed planting to salable stock. We have budded the nursery under the overhead and there has been no harm or disadvantage in wetting the buds and wrappings before they start growth.

In preparing land for furrow irrigation it is necessary to bring it to grade by cutting off the high spots and filling the low places. This is not only expensive, but it results in bald spots wherever the surface soil is removed to any depth. In such areas the trees are usually backward in development and as a result the grove lacks uniformity. These expenses and difficulties are entirely done away with when overhead irrigation is decided on and the underground part of the system put in without grading before the trees are planted.

In the event that no intercrop is intended, the uprights and sprinklers need not be installed for two or three years. Garden valves may be set at suitable intervals and the manure-filled basins about the trees watered with a hose. This requires more labor but less water and insures each and every young tree getting individual attention.

THERE is a common opinion that overhead irrigation is attended by excessive losses by evaporation. While it is impossible to measure this loss, it is my opinion that it is more than compensated for by savings made through elimination of run-off and excessive depth of percolation. My experience is that the overhead requires less water, and by perfect distribution results in better growth of trees. Furthermore, evaporation is not always an unmixed evil, and may sometimes prove a good thing. Occasionally East winds of high temperature and very low humidity blow from the desert with considerable force. Such winds always do more or less damage by drying out the foliage and causing the fruit to drop. I have found that by running the sprinklers for ten-minute periods at intervals of several hours, the rapid evaporation of moisture cools and humidifies the air with marked benefit to the trees. There is no danger of scalding the foliage by sprinkling during sunshine, as some persons imagine.

As an aid to starting an early cover-crop, overhead irrigation stands preeminent. Every rancher knows the difficulty of getting a uniform stand of cover-crop in early September by furrow irrigation. The same furrows are necessarily used for successive irrigations and soon become baked and shed water rather than absorb it. Small seeded crops like *melilotus indica* need frequent surface wettings until the little rootlets are down to

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Affords an immense saving in labor. Simply open the valves and let it "rain" on a section of one, five or ten acres for a few hours—then shut off and turn on another section. No furrowing needed in advance of irrigating.

Obviates the necessity of terracing and contour planting—even on the steepest hillsides. Trees can be planted square and every drop of water applied will soak in.

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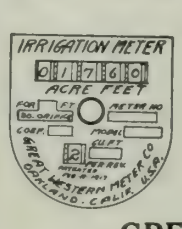

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some depth. The sprinklers accomplish this very nicely, and bring about an even germination over all the area between the trees.

After several years experience with overhead irrigation on avocados, I find it convenient, economical, and productive of satisfactory growth and general health of the trees.

Overhead System Gives Efficient Distribution, Says Engineer

Describes Advantages and Needs of Overhead Sprinklers as At Present Developed

By A. G. GRAHAM

Various methods of irrigation are employed in distributing water over the land and, as in other forms of farm management, new and improved methods are constantly being adopted in irrigation practice. Commercial growers of fruit and vegetables in nearly every part of the country realize that there are periods during the growing season when the crop could be saved, or its value doubled, could they but receive a soft gentle rain of sufficient duration to furnish the desired moisture. The normal precipitation of rainfall in most sections, even in the so-called arid region of this country, is sufficient to mature crops but the distribution being beyond our control, water must be supplied when needed by artificial means. Nature's method of supplying moisture—in the form of gentle rain drops—is the ideal way and the nearer we can come to duplicating nature's method, the better the results will be.

The overhead method of irrigation has been practiced for a number of years, but it has only been within the past five years that any extensive operations have been carried on in southern California. From the investigations which have been made, certain underlying principles have been evolved, the practice of which has greatly increased the yield of crops as compared with other methods of applying water to the land. The results have demonstrated that profitable crop increases can be produced under scientific irrigation.

Efficiently to apply water to the land it is necessary to have absolute uniformity of distribution, so that all parts of the field may receive their proper amount of water. It is equally essential that no more water than plants require be furnished, and the practice of overwatering some portions in order that water may be carried to all parts of the field has resulted in many cases in waterlogging the soil. Repeated investigations have shown that over-watering is even more injurious than underwatering.

Growers are beginning to realize that the effects on the soil, resulting from the various methods of irrigating, have a decided bearing on plant growth. The texture of the soil is an important factor in the growth of plants. The soil, when over-watered, is not in a proper physical condition to allow of the free passage of air through it, and air is an important factor in plant growth. With the overhead method of irrigation, the water is distributed over the land uniformly and in the percolation of moisture down through the soil, the available plant food is carried to the hair-like roots, which are the ones that absorb the food necessary for plant growth.

The moisture is furnished in the form of a thin film surrounding the soil particles. Another important result which is noted when the overhead method of irrigation is practiced is that of supplying moisture to the leaves of plants. Plants breathe air through the pores of the leaves. The water removes the accumulated dust from the leaves, thus enabling them better to perform their work as nature intended they should.

Citrus growers have become interested in this method of irrigation and there are now between five hundred and one thousand acres of orange and lemon trees irrigated by means of sprinkler heads extending up over the tree tops. A decided interest in overhead systems is being taken by growers of crops which bring large money returns per acre, and it has been demonstrated to the satisfaction of many orchardists that better quality and quantity of oranges and lemons have been the result when water was applied in this manner.

The need now is for a type of sprinkler head which will be small and compact and at the same time have a wide sweep, and one that will operate efficiently over a long period of time, thus lowering the cost of installation and operation. A sprinkler head which, it is claimed, will ideally meet the requirements of orchardists and others who wish to irrigate large tracts of land, has been worked out in the laboratory of a California manufacturer, is now being thoroughly tested, and will soon be ready for demonstration.

Sunnyside Water Works Sold

D. G. Johns, having acquired the one-half interest of G. R. Goold in the Sunnyside Water Works System, formerly operated jointly by Johns and Goold in the Sunnyside Addition of the City of Stockton, has applied to the California Railroad Commission for approval of such transfer, and for permission to resell to Joseph Herring the system for the sum of $4,000.

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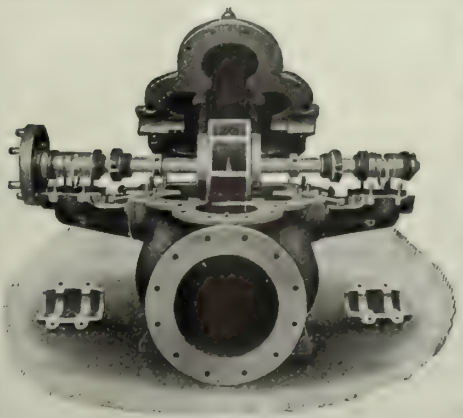

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SURVEY *of* IRRIGATION DEVELOPMENT

As Shown by Official Records of the Month -- Local, State, and Governmental

BIG DEVELOPMENTS CONTEMPLATED IN PERMITS

AMONG the permits to appropriate water issued by the Department of Public Works, Division of Water Rights of California during the month of July, 1925, were the following:

Permit No. 2153, Application No. 2526 (San Bernardino County). Issued to G. M. Bartlett and R. L. Bartlett, Pine Knot, California, July 13, 1925, for 0.077 cubic feet per second from Talmadge Creek and cienega at head of Seeley Creek in Section 25, T 2 N, R 1 W, for domestic purposes in Section 25. Estimated cost $20,000.

Permit No. 2154, Application No. 3979 (Inyo County). Issued to Mary A. Thompson, Trona, California, July 15, 1925, for 1.25 cubic feet per second from Surprise Canyon tributary to Panamint Valley Sink in Section 16, T 21 S, R 45 E, M. D. M. for generation of electric power in said Section 16. Twenty-eight T. H. P. to be developed. Estimated cost $12,000.00.

Permit No. 2155, Application No. 4561 (Siskiyou County). Issued to McCloud River Lumber Company, McCloud, California, July 15, 1925, for 5.57 cubic feet per second from the McCloud River in Section 7, T 39 N, R 1 W, M. D. M. for water supply for the town of McCloud. Estimated cost $75,000.00.

Permit No. 2156, Application No. 4536 (El Dorado County). Issued to Rose V. Jones, Vallejo, California, July 17, 1925, for 75 acre feet per annum from Little Iowa Creek tributary to South Fork American River in Section 33, T 11 N, R 12 E, M.D.M. for irrigation of 138,588 acres in Sections 33 and 34, T 11 N, and Sec. 3, T 10 N, all in R 12 E, M.D.M. Estimated cost $4,000.00.

Permit No. 2157, Application No. 4428 (Mendocino County). Issued to C. H. Smith, Redwood Valley, California, July 25, 1925, for 1.13 cubic feet per second from Redwood Valley branch of Russian River in Section 32, T 17 N, R 12 W, M.D.M. for irrigation of 90.38 acres in projected Section 32, T 17 N, R 12 W. Estimated cost $1,000.00.

Permit No. 2158, Application No. 4456 (Mendocino County). Issued to Hanly A. Ford (for F. A. Ford heirs) Ukiah, California, July 25, 1925, for 0.87 cubic foot per second from Russian River in Section 33, T 16 N, R 12 W, M.D.M. for irrigation of 70 acres in Lot 140 of Yokayo Rancho. Estimated cost $2,150.00.

Permit No. 2159, Application No. 3817 (Mendocino County). Issued to Peter Fray and Jesse I. Jewel, Ukiah, California, July 25, 1925, for 1.87 cubic feet per second from Russian River in Section 4 (projected) T 15 N, R 12 W, M.D.M. for irrigation of 150 acres within Lot 12 of Yokayo Rancho. Estimated cost $8000.00.

Permit No. 2160, Application No. 4258 (Stanislaus County). Issued to August Henry Voight, Modesto, California, July 25, 1925, for 0.23 cubic foot per second from Tuolumne River in Sec. 5, T 4 S, R 10 E, for irrigation of 18.13 acres near point of diversion. Estimated cost $1,500.00.

Permit No. 2161, Application No. 4520 (San Joaquin County). Issued to O. C. Cutts, Stockton, California, July 25, 1925, for 1.12 cubic feet per second from San Joaquin River in Section 5, T 1 S, R 6 E, for irrigation of 90 acres in Section 5.Estimated cost $1,500.00.

Permit No. 2167, Application No. 4154 (Los Angeles County). Issued to Simon Kuenzel, Llano, California, July 25, 1925, for 0.02 cubic foot per second from Cottonwood Canyon Spring in Sec. 22, T 4 N, R 8 W, S.B.M. for irrigation of 40 acres within Sec. 7, T 4 N, R 7 W, S. B. M. to be commingled with other waters.

Permit No. 2169, Application No. 3195 (Sutter County). Issued to Sutter Basin Company, California Fruit Bldg., Sacramento, California, July 25, 1925, for 1.38 cubic feet per second from Sacramento River in Sec. 18, T 11 N, R 3 E, M.D.M. for irrigation of 110.8 acres in Sutter Basin Subdivision No. 1.

Permit No. 2170, Application No. 3199 (Sutter County). Issued to Sutter Basin Company, California Fruit Bldg., Sacramento, California, July 25, 1925, for 1.07 cubic feet per second from Sacramento River in Sec. 34, T 12 N, R 2 E, M.D.M. for irrigation of 86 acres within SE ¼ of Section 34 and SW ¼ of Section 35, all in T 12 N, R 2 E. Estimated cost $5,000.00.

Permit No. 2171, Application No. 3200 (Sutter County). Issued to Sutter Basin Company, California Fruit Bldg., Sacramento, California, July 25, 1925, for 1.15 cubic feet per second from Sacramento River in Sec. 27, T 12 N, R 2 E, M.D.M. for irrigation of 92 acres in Subdivision No. 4 Sutter Basin Company. Estimated cost $5000.00.

Permit No. 2172, Application No. 3201 (Sutter County). Issued to Sutter Basin Company, California Fruit Bldg., Sacramento, California, July 25, 1925, for 0.72 cubic feet per second from Sacramento River in Sec. 29, T 12 N, R 2 E, M.D.M. for irrigation of 58 acres within Subdivision No. 4 of Sutter Basin Co., being also within NE ¼ Sec. 29, T 12 N, R 2 E. Estimated cost $5000.00.

Permit No. 2173, Application No. 3202 (Sutter County). Issued to Sutter Basin Company, California Fruit Bldg., Sacramento, California, July 25, 1925, for 1.88 cubic feet per second from Sacramento River in Sec. 2, T 12 N, R 1 E, M.D.M. for irrigation of 150.48 acres in said Section 2. Estimated cost $5000.00.

Permit No. 2174, Application No. 3205 (Sutter County). Issued to Sutter Basin Company, California Fruit Bldg., Sacramento, California, July 25, 1925, for 15.21 cubic feet per second from Sacramento River in Section 22, T 11 N, R 3 E, M.D.M. for irrigation of 608.5 acres in Sections 20 and 21, T 11 N, R 3 E. Estimated cost $7000.00.

Permit No. 2175, Application No. 3206 (Sutter County). Issued to Sutter Basin Company, California Fruit Bldg., Sacramento, California, July 25, 1925, for 87.49 cubic feet per second from Feather River in Section 9, T 11 N, R 3 E, M.D.M. for irrigation of 3499.6 acres in Sections 32, 33, 34, T 12 N, R 3 E, Sections 4, 5, 8, 9, 10, 15, 16, 21, 22, T 11 N, R 3 E, M.D.M. Estimated cost $30,000.00.

Permit No. 2176, Application No. 3207 (Sutter County). Issued to Sutter Basin Company, California Fruit Bldg., Sacramento, California, July 25, 1925, for 53.17 cubic feet per second from Feather River in Section 22, T 12 N, R 3 E, M.D.M. for irrigation of 2126.65 acres within Sections 10, 14, 15, 21, 22, 23, 27, 28, T 12 N, R 3 E. Estimated cost $20,000.00.

Permit No. 2177, Application No. 3208 (Sutter County). Issued to Sutter Basin Company, California Fruit Bldg., Sacramento, California, July 25, 1925, for 18.14 cubic feet per second from Feather River in Section 10, T 12 N, R 3 E, M.D.M. for irrigation of 725.67 acres within Sections 3, 4, 9, 10, 15, 16, T 12 N, R 3 E. Estimated cost $3500.00.

Permit No. 2178, Application No. 4176 (Riverside County). Issued to H. G. Tarbett, Wildomar, California, July 25, 1925, for 0.05 cubic foot per second from unnamed spring, Elsinore Lake drainage in Section 33, T 6 S, R 4 W, S.B.M. for irrigation of 40 acres. Estimated cost $2,000.00.

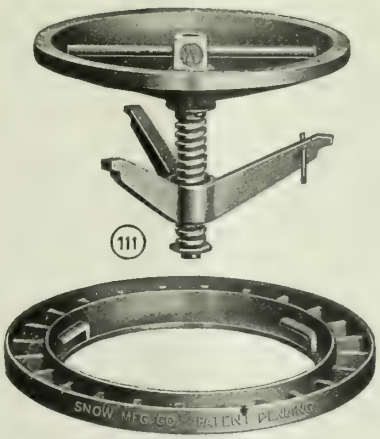
Permit No. 2179, Application No. 4485 (Humboldt County). Issued to David S. Ward, Eureka, California, July 25, 1925, for .62 cubic foot per second from Freshwater Creek, tributary to Humboldt Bay in Section 33, T 5 N, R 1 E, H.M. for irrigation of 49.6 acres in above Section. Estimated cost $1250.00.

Permit No. 2180, Application No. 4499 (Mendocino County). Issued to Charles S. Howard Company, San Francisco, California, July 28, 1925, for 4.46 cubic feet per second and 300 acre feet per annum from Forsythe Creek in Section 18, T 17 N, R 13 W. M.D.M. for irrigation of 357 acres near point of diversion.

Permit No. 2181, Application No. 4168 (San Diego County). Issued to Joseph Poggi, Chula Vista, California, July 31, 1925, for 1.16 cubic feet per second from well in Valley of Sweetwater River in Sec. 34,

·SNOW·

IRRIGATION & WATER CONTROLLING APPLIANCES



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T 17 S, R 2 W, S.B.M. for irrigation of 93 acres in Rancho de la Nacion in quarter sections 125 and 126.

Permit No. 2182, Application No. 4169 (San Diego County). Issued to Joseph Poggi, Chula Vista, California, July 31, 1925, for 0.19 cubic foot per second from well in Sweetwater River in Section 27, T 17 S, R 2 W, S.B.M. for irrigation of 15 acres in quarter section 126 of Rancho de la Nacion. Estimated cost $1500.00.

Applications Filed

Among the applications for permit to appropriate water filed with the State Department of Public Works, Division of Water Rights, (California) during the month of July were the following:

Application No. 4670 (Ventura County)—Frank Buren, trustee, 1329 Stock Exchange Bldg., Los Angeles, California, for 200 cubic feet per second and 15,000 acre feet per annum from Sespe Creek, tributary to Santa Clara River, to be diverted in Sec. 15, T 5 N, R 20 W, S.B.M. To be used for agricultural purposes on 10,000 acres.

Application No. 4672 (Modoc County)—Mary E. Harbert, Adin, California, for 0.75 cubic foot per second from three unnamed springs, tributary to Ash Creek and Pit River, to be diverted in Sec. 21, T 39 N, R 9 E, M.D.M. for agricultural purposes on 60 acres in Sec. 28, T 39 N, R 9 E, M.D.M. Estimated cost $500.00.

Application No. 4676 (Ventura and Los Angeles Counties) — Ventura Power Company, 1121 Balfour Bldg., San Francisco, for (1) 200 cubic feet per second and (2) 75,000 acre feet per annum from Piru Creek, tributary to Santa Clara River, to be diverted in (1 and 2) Sec. 30, T 7 N, R 18 W; Sec. 3, T 6 N, R 18 W, and (1) Sec. 34, T 5 N, R 18 W, S.B.M. To be used for agricultural purposes.

Application No. 4677 (Ventura County)—Ventura Power Co., 1121 Balfour Bldg., San Francisco, for (1) 200 cubic feet per second and (2) 111,800 acre feet per annum from Sespe Creek, tributary to Santa Clara River, to be diverted in (1 and 2) Sec. 2, T 4 N, R 20 W, and (2) Sec. 6 ,T 5 N, R 22 W, and Sec. 36, T 6 N, R 20 W, S.B.M. To be used for agricultural purposes.

Application No. 4681 (Yuba County)—Dry Creek Irrigation District, care Roscoe S. Creps, Wheatland, California, for 25 cubic feet per second and 17,000 acre feet per annum from Dry Creek, tributary to Feather River, to be diverted in Section 32, T 15 N, R 6 E, M.D.M., to be used for agricultural purposes in proposed Dry Creek Irrigation District.

Application No. 4682 (Inyo County) — Burchard Fine, Coso Junction, Inyo County, California, for 0.75 cubic foot per second from East Sacatar Creek, tributary to Sacatar Canyon, to be diverted in Sec. 21, T 22 S, R 37 E, M.D.M. for irrigation on about 100 acres in Secs. 21 and 22, T 22 S, R 37 E, M.D.M.

Application No. 4685 (San Diego County) —Geo. T. Simpson, 1230 B Street, San Diego, Calif., for 1.69 cubic feet per second and 150 acre feet per annum from Santa Maria Creek, tributary to San Pagual Creek, to be diverted in Section 11, T 13 S, R 1 W, S.B.M. for agricultural and domestic purposes on 135 acres in Sec. 11, T 13 S, R 1 W, S.B.M. Estimated cost $6,000.00.

Application No. 4688 (Riverside County) —Philip Playter, Box 1780, Arcade Station, Los Angeles, Calif., for 1.0 cubic foot per second from Santa Margarita River, tributary to Pacific Ocean, to be diverted in Sec. 33, T 8 S, R 3 W, S.B.M. for irrigation and domestic purposes, Sec. 33 and 34, T 8 S, R 3 W, S.B.M.

Application No. 4689 (Plumas County)—Feather River Power Co., Hobart Bldg., San Francisco, for 80,000 acre feet per annum from Middle Fork Feather River, tributary to Feather River, to be diverted in Section 23, T 22 N, R 12 E, M.D.M. and Sec. 15, T 21 N, R 6 E, M.D.M. for generation of hydro-electric energy in Sec. 8, T 20 N, R 6 E, M.D.M. Estimated cost $1,250,000.00.

Application No. 4690 (Mendocino County) —Charles Thomas Smith, Hopland, California, for 1.0 cubic foot per second from Russian River, tributary to Pacific Ocean, to be diverted in Sec. 33, T 13 N, R 11 W, M.D.M. for agricultural purposes on 80 acres in Secs. 32 and 33, T 13 N, R 11 W, M.D.M.

Application No. 4692 (Santa Barbara County)—Union Sugar Co., care McKinstry, Faber & Firebaugh, 703 Market St., San Francisco, for 3.60 cubic feet per second from Santa Ynez River, tributary to Pacific Ocean, to be diverted in Sec. 23, T 7 N, R 35 W, S.B.M., for agricultural purposes on 288 acres in Sec. 23, T 7 N, R 35 W, S.B.M.

Application No. 4697 (Inyo County)—E. H. Cook and James F. Chrysler, Lone Pine, for 0.375 cubic foot per second from Coyote Creek, tributary to Owens Valley Watershed, to be diverted in Sec. 30, T 16 S, R 36 E, M.D.M. for agricultural and domestic purposes on 40 acres in Sec. 31, T 16 S, R 36 E, M.D.M. Estimated cost $2,000.00.

Application No. 4698 (Santa Clara County)—Montezuma Mountain Ranch School, Collins Creek, for 0.25 cubic foot per second from Collins Creek, tributary to Los Gatos Creek drainage area, to be diverted in Sec. 6, T 9 S, R 1 W, M.D.M. for domestic and agricultural purposes on 15 acres in Sec. 6, T 9 S, R 1 W, M.D.M. Estimated cost $12,000.00.

Application No. 4699 (Sutter County)—Geo. E. Springer, 351 California St., San Francisco, California, for 2.0 cubic feet per second from Sacramento River, tributary to Suisun Bay, to be diverted in Section 8, T 14 N, R 1 E, M.D.M. for agricultural purposes on 160 acres in Sec. 11, T 14 N, R 1 E, M.D.M. Estimated cost $25,500.00.

Application No. 4701 (Sierra County)—E. O. Carvin, care Geo. F. Taylor, Downieville, California, for 10 cubic feet per second from North Fork of South Fork of North Fork of Yuba River, tributary to Yuba River, to be diverted in Sec. 6, T 20 N, R 13 E, M.D.M. for power purposes in Sec. 1, T 20 N, R 12 E, M.D.M. Estimated cost $10,000.

Application No. 4702 (Butte County)—A. G. Eames, care Chico Chamber of Commerce, Elks Bldg., Chico, Calif., for 500 cubic feet per second and 100,000 acres feet per annum from Butte Creek, tributary to Sacramento River, to be diverted in Sec. 4, T 21 N, R 2 E, M.D.M. for agricultural purposes on 40,000 acres in T 22 N, Rgs. 1 E and 1 W, and T 21 N, Rgs 1 and 2 E, and T 20 N, Rgs 1 and 2 E.

Application No. 4703 (Fresno County)—San Joaquin Light & Power Corporation, Fresno, California, for 220 cubic feet per second from North Fork of Kings River, tributary to Kings River, to be diverted in Sec. 6, T 11 S, R 28 E, Sec. 1, T 11 S, R 27 E, Sec. 3, T 12 S, R 27 E, Secs. 10 and 12, T 12 S, R 26 E, M.D.M. for generation of hydro-electric energy in Sec. 6, T 11 S, R 28 E, Sec. 34, T 11 S, R 27 E, and Sections 12, 11 and 19, T 12 S, R 26 E, M.D.M. Total T.H.P. to be developed, 141,750. Estimated cost $32,300,000.00.

Application No. 4704 (Fresno County)—San Joaquin Light & Power Corporation, Fresno, California, for (1) 135, (2) 60, (3) 105, (4) 30, total 330 cubic feet per second from (1) North Fork Kings River, (2) Fleming Creek, (3) Post Corral Creek, (4) Helms Creek, tributary to North Fork Kings River and Kings River to be diverted in Sec. 7, T 10 S, R 29 E, Sec. 1, T 10 S, R 28 E, Sec. 35, T 9 S, R 28 E, Sec. 7, T 10 S, R 28 E, M.D.M. for generation of hydro-electric energy in Section 30, T 10 S, R 28 E, M.D.M. T.H.P. to be developed, 60,750. Estimated cost $10,000,000.00.

Application No. 4705 (Fresno County)—San Joaquin Light & Power Co., Fresno, California, for 86,000 acre feet per annum from (1) Seven unnamed lakes in Fleming Basin, (2) Four unnamed lakes in Red Mountain Basin, (3) Devils Punch Bowl Lake, (4) seven unnamed lakes in Bench Valley Basin (5) five unnamed lakes in Black Cap Basin, (6) Half Moon Lake, (7) North Fork Kings River, (8) Fleming Creek, (9) Post Corral Creek, (10) Helms Creek, tributary to North Fork Kings River and Kings River to be diverted in T 9 and 10 S, R 27, 28, 29 and 30 E, M.D.M., as shown on maps on file with the Division of Water Rights, for generation of hydro-electric energy in NE ¼ of Section 30, T 10 S, R 28 E, M.D.M. T.H.P. to be developed, 60,750. Estimated cost $10,000,000.00.

Application No. 4706 (Los Angeles County)—City of Alhambra, care T. B. Downer, Alhambra Water Department, Alhambra, California, for 30,000 acre feet per annum from San Gabriel River, tributary to Pacific Ocean, to be diverted in Sec. 13, T 1 N, R 10 W, S.B.M. for municipal purposes.

Application No. 4710 (Lake, Napa, Solano counties)—B. C. Rogers, 3335 Fernside Ave., Alameda, Calif., for 750 cubic feet per second and 300,000 acre feet per annum from Putah, Pope and Eticura Creeks, tributary to Sacramento River, to be diverted in Sec. 25, T 8 N, R 2 W, M.D.M. to be used for agricultural purposes on 60,000 acres. Estimated cost $150,000.00.

Application No. 4711 (Riverside County) —John Terribilini, care Davidson and Fulmore, 646 W. 7th St., Riverside, California, for .25 cubic foot per second from underground water tributary to San Jacinto River, to be diverted in Sec. 2, T 4 S, R 1 E, S.B.M. to be used for agricultural and domestic purposes on 30 acres in Sec. 2, T 4 S, R 1 E, S.B.M. Etimated cost $4,000.00.

Application No. 4712 (Placer County)—Mt. Pleasant-Lincoln Irrigation District, care E. Emerson, Hoar Co., 995 Market St., San Francisco, California, for 300 cubic feet per second and 100,000 acre feet per annum from Bear River, tributary to Feather River, to be diverted in Sec. 2, T 13 N, R 8 E, M.D.M. for agricultural and domestic purposes on 600,000 acres in T 12 N, Rgs 5, 6, 7 E and T 13 N, Rgs 5, 6, 7 E, M.D.M.

Application No. 4715 (Lake, Napa, Yolo, Solano Counties)—B. C. Rogers, 3335 Fernside Blvd., Alameda, for 1500 c.f.s. and 340,000 a.f.a. from Putah, Pope, Capell, Eticura Creeks and tributaries, tributary to Sacramento River, to be diverted in Sec. 25, T 8 N, R 2 W, M.D.M. for agricultural purposes on 120,000 acres. Estimated cost $150,000.00.

OREGON

The following list includes the more important applications as filed in the office of Rhea Luper, State Engineer, of Oregon, for the last month for which records are available:

L. F. Sandoz, of The Dalles, covering the appropriation of water from Mill Creek for irrigation of 5 acres in Wasco County, at a cost of $1,500.

Leonard H. Hildeman of Portland, covering the appropriation of water from Buckner Creek for irrigation purposes.

Maggie Henderson of Pendleton, covering the appropriation of water from Catherine Creek for supplemental irrigation of 98.25 acres in Union County.

B. J. Crowley of Lakeview, covering the construction of the Bull's Prairie Reservoir for storage of 809 acre feet of water from Mud Creek, and the appropriation of the stored water for development of 100 theoretical horsepower and domestic purposes in Lake County, at an approximate cost of $30,000.

Mrs. Almeda T. Bowles of Seattle, covering the appropriation of water from Johnson Creek for irrigation of 5 acres in Multnomah County, at a cost of approximately $10,000.

Phil J. Keizer of North Bend, covering the appropriation of water from Kentuck Inlet Creek with North Fork of Kentuck Inlet Creek for municipal water supply for city of North Bend, in Coos County.

E. A. Clark of Milwaukie, covering the appropriation of water from an unnamed stream for irrigation of 30 acres in Clackamas County, at a cost of $800.

Phil J. Keizer of North Bend, covering the apropriation of water from West Fork of Millicoma River for a municipal water supply for city of North Bend, in Coos County.

W. G. Baker of Eugene, covering the appropriation of water from Minnie Creek for irrigation of 40 acres, development of 6.8 theoretical horsepower, and domestic purposes including supply for proposed camp ground or summer resort, in Lane County, at a cost of $1,000.

New Incorporations

The following new water companies have been incorporated in California during the last month for which official records are available:

No. 114938—ARVIN MUTUAL WATER CO., (a California company). Directors: E. C. O'Boyle, Bakersfield; T. N. Harvey, Bakersfield; Geo. A. Osner, Arvin; Eugene Stroud, Arvin; C. W. Chaplin, Arvin, (each 1 share). Date of filing, July 14, 1925. Capital stock, $50,000. Par value, $100. Amount subscribed, $500. Place of business, Arvin, Kern County, California.

Purposes—"To dispose of water to stockholders at cost; operate wells and pumping plants."

Articles filed by Wiley & Harvey, 19 Security Trust Co. Bldg., Bakersfield.

No. 115114—BALLONA WATER COMPANY, (a California company). Directors: F. J. Seymour, Edna G. Tobias, Hulda Wurts, all of Los Angeles, (each 1 share). Date of filing, July 30, 1925. Place of business, Los Angeles. Capital stock, $150,000. Par value, $100. Amount subscribed, $300.

Purposes—"To supply water for domestic and agricultural uses."

Articles filed by Moote & Patterson, 515 H. W. Hellman Bldg., Los Angeles.

No. 115121—HILLCREST KNOLLS WATER CO., (a California company). Directors: Sol Koff, 535 Taylor street, San Francisco; Sol Rubinstein, 535 Taylor street, San Francisco; C. Nunlist, 6749 California street, San Francisco; C. Sousa, Berry avenue, Hayward; E. Massey, 668 Brooklyn avenue, Oakland; (each 1 share). Date of filing, July 30, 1925. Place of business, Oakland. Capital stock, $46,300. Par value, $100. Amount subscribed, $500.

Purposes—"To supply water for domestic and irrigation solely to its stockholders and conduct business without profit."

Lands to be supplied with water are known as Hillcrest Knolls, Alameda County, California.

Articles filed by Norman A. Eisner, 344 Mills Bldg., San Francisco.

No. 115132—HOMEWOOD MUTUAL WATER CO., (a California company). Directors: Ralph P. Maskey, Wm. A. Bowen, W. H. Schroder, Maud Mowry, all of Los Angeles; S. E. Shafer, Buena Park, (each 1 share). Date of filing, July 31, 1925. Place of business, Los Angeles. Capital stock, $25,000. Par value, $25. Amount subscribed, $125.

Purposes—"To distribute water among its stockholders at cost who own land within the present limits of tracts numbered 625, 714, 722, 729, and 650 County of Orange, California."

Articles filed by W. R. Schroder, 300 Corporation Bldg., Los Angeles.

No. 115167—LAGUNA-MAYWOOD MUTUAL WATER CO. NO. 1, (a California company). Directors: S. C. Graham, F. M. White, J. S. Valentine, Lillian Bischoff, Kay S. Santoro, all of Los Angeles, (each 1 share). Date of filing, August 3, 1925. Place of business, Los Angeles. Capital stock, $25,000. Par value, $1.00. Amount subscribed, $5.00.

Purposes—"To bore and maintain wells and pumping plants, to distribute water to its stockholders at cost for use on lands owned by the Laguna-Maywood Land Corporation deed to them by the Arcadia Bandini Baker Estate containing 428.236 acres net."

Articles filed by John E. Biby, 1015 Citizens National Bank Bldg., Los Angeles.

No. 115194—TOPANGA PARK MUTUAL WATER CO., (a California company). Directors: J. H. Bonnell, H. J. Ruess, Geo. M. Adair, E. D. Halliwell, Los Angeles; R W. Gammon, Topanga, California, (1 share each). Date of filing, August 5, 1925. Place of business, Los Angeles. Capital stock, $1.000. Par value, $1.00. Amount subscribed, $5.00.

Purposes—"To supply water to stockholders and not for public."

Articles filed by John Schlegel, 322 H. W. Hellman Bldg., Los Angeles.

No. 115259—THE TOPANGA BEACH WATER ASSOCIATION, (a California company). Directors: G. E. Alexander, 724 South Los Angeles street; Fred Mansur, 827 Coronado Terrace; Josiah F. Lyon, 312 Pacific Electric Building; Geo. W. Mackie, 257 Werdin Place; I. K. Loomis, 228 South Los Angeles street, all of Los Angeles. Date of filing, August 10, 1925. Place of business, Topanga Beach, Los Angeles County. Capital stock, none. Membership fee, $15.00.

Purposes—"To own and develop lands and subdivide for residences and farms and to drill for water and sell water for domestic and irrigation purposes and charge rates and tolls for same."

Articles filed by Fred Mansur, 718 Title Insurance Bldg., Los Angeles.

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For Detailed Listings, Branch Offices, Etc., See the Buyers' Guide to Leading Supply Sources—Pages 55-56

AMONG OUR CONTRIBUTORS

Editorial Jottings About Current and Forthcoming Feature Articles, Dealing With Practical Problems of Hydraulics, and the Men Who Have Written Them

MEN who are actually doing things in irrigation—who are in daily touch with the practical affairs of the irrigation district, or the water company are the men who are writing for MODERN IRRIGATION. It is this type of contributor that has something definite to tell our readers. In this issue, such contributors have a predominant place.

H. I. Wood, construction engineer, who contributes to this number a description of the development work now being completed in the Roosevelt Water Conservation District, has been in active contact with the activities in this section of Arizona. Mr. Wood is associated with Fred Tibbetts, well-known consulting engineer of San Francisco, and represented him in co-operation with Reed and Baker, of Phoenix, who are the engineers of the Roosevelt Water Conservation District, in supervising the recent developments there.

EARL C. POUND, who has written for this issue a discussion of the reorganization program undertaken by the Imperial Irrigation District, is president of the district, and, as such, a prominent figure in irrigation affairs in the west. Probably no single irrigation district in the west, unless it might possibly be the Salt River Valley project, is so well known outside of its own immediate territory. Recently this district, and its board of directors, have been even more prominently in the lime-light of public attention as the result of internal controversies. The directors of the district have been accused of using undue influence in aiding the political fortunes of the Swing-Johnson bill for the development of the Colorado River, and four of them are now facing accusations preferred by the grand jury. Simultaneously they have launched a reorganization plan, based on the need for economy in the affairs of the district, which has resulted in the dismissal of several major employees of the district.

Believing that almost every reader of MODERN IRRIGATION would be interested in hearing Mr. Pound's explanation of the troubled situation in his district, the editor invited him to give his own story of the plans and purposes of the Board of Directors. His article, beginning on page 13, is the result.

MEMBERS of the editorial staff have prepared the articles on pages 14, 15, and 16, the first of which deals with the magazine's Board of Advisors and introduces the three men who constitute the group on that board representing the Irrigationists; the second summarizing the events of the recent Tri-State Colorado River conference at Phoenix; and the third giving some advance information on the Oregon Irrigation Congress, which meets early in October in Grant's Pass, Oregon.

JOHN R. JAHN is an irrigation engineer who is especially interested in the mathematical and economic aspects of that many-sided profession. His article on the necessity for economic analysis in irrigation engineering will be of interest not only to the engineers among our readers, but to all who are interested in the problems involved in determining the financial feasibility of a given task in irrigation.

Throughout his experience Mr. Jahn has been primarily interested in engineering mathematics, and has a record of real accomplishment in simplifying some of the formulae and mathematical processes used by irrigation engineers. He is the inventor of the "Hydraulic Calculator" for the solution of flow-of-water problems by means of a straight-line diagram chart. He has also devised an ingenious method of surveying topography, using logarithmic processes.

Mr. Jahn has had considerable practical field experience as assistant engineer on the Delhi and Durham projects in California under Dr. Elwood Mead, and for the past several years has been in private practice. He has done special work for Charles H. Lee, Fred H. Tibbetts, and W. F. McClure, California state engineer. His home and office are in Berkeley, California.

AS A CONSULTING horticulturist of Southern California, Raymond E. Nebelung is vitally interested in problems of water supply and water use, and his article in this issue, dealing with some of the special irrigation problems which attend an abnormally low water level, is intended to be helpful to irrigators and irrigation executives who are this year faced with the knotty question of a low water table.

Mr. Nebelung was graduated from the College of Agriculture of the University of California in 1914, having specialized in citriculture during his course. From 1918 to 1921, he served as Farm Advisor in Riverside County. In 1921 and 1922 he was in South Africa as a citrus specialist for the Division of Horticulture of the government of the Union of South Africa, and since 1922 has been acting as a consulting horticulturist in Orange and Riverside counties. In addition to his consulting work, Mr. Nebelung exercises supervision over a number of citrus groves which are owned by non-residents.

OTHER contributors in this issue are men equally well qualified to discuss the problems on which they write. Harvey S. Bissell is well known among men interested in irrigation and conservation in southern California and the entire west. He has been prominent in the affairs of the Southern California Conservation Association, of which he tells in his article, and is now first vice-president of that organization. His home is in La Crescenta, California. W. H. Nalder is a successful engineer employed by the U. S .Bureau of Reclamation. Hubert Work, whose speech recently delivered at American Falls, Idaho, is reprinted in this issue, is secretary of the Department of Interior. S. M. Haskins, author of the article on the California Irrigation District Act, is a member of the legal firm of Gibson, Dunn & Crutcher, Los Angeles. J. Eliot Coit is an agriculturist of practical experience, and proprietor and director of the Coit Agricultural Service.

EDWARD HYATT, JR., chief of the Division of Water Rights of the California State Department of Public Works, is another man whose daily activities bring him into touch with many types of irrigators in many parts of the west. In a recent conference with the editor Mr. Hyatt outlined a series of articles which are to be prepared, by engineers of his Division, for later publication in MODERN IRRIGATION.

These articles will be written not only from the standpoint of the California irrigator, who is interested in improving his acquaintance with the functioning of this department of the state government, and which bears such a direct relationship to irrigation activities, but from the standpoint also of readers throughout the west. The latter, of course, have a real concern in comparing their own state systems of water control with that in effect in California, where it may be said that irrigation is farthest advanced in many ways.

SUCH topics as "The Benefits of Distribution of Water by Water Masters"; "Methods of Determination of Water Rights"; and "How the Division of Water Rights Functions" will be discussed in this series, each article being prepared by an expert in the particular line involved. Reports of the actual work being accomplished by the Division will also be presented through the columns of MODERN IRRIGATION, from time to time.

BEGINNING in a very modest way in this issue, MODERN IRRIGATION will maintain an editorial department devoted to the problems and concerns of municipal water works and water companies serving the domestic demand of cities. Some very interesting features are planned for this department for forthcoming numbers. One of the first of these will be an article descriptive of the Garza Dam, which is being constructed by the city of Dallas, Texas, to create a new reservoir for municipal purposes. This dam is now about fifty per cent completed, and the structure itself, exclusive of lands, clearing, revision of road systems, etc., will cost about $3,500,000. R. A. Thompson, formerly chief engineer of the Railroad Commission, State of California, and now a member of Nagle & Thompson, water reservoir engineers of Dallas, will write the article describing the work entailed in the construction of this big dam.

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Published Monthly by Petroleum World Publishing Company, Inc.; Copyright, 1925; All Rights Reserved.
For 12 Months: $2.00; Single Copies: 20 cents.

Owen Brown, President. W. C. Monroe, Vice-Pres. and Gen. Mgr. Minor Moore, Sec'y and Counsel

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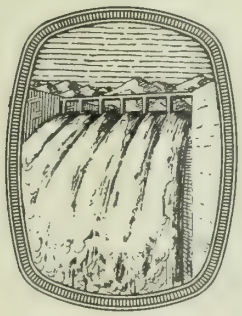
Petroleum World 626 S. SPRING ST., LOS ANGELES, CALIF. Modern Irrigation

CLARENCE J. MORLEY

Governor of the State of Colorado, and a leader of the group of upper basin state governors who have injected a new angle into the tangled Colorado River problem by their declaration in opposition to any developments on the lower river until the rights of the upper states are safeguarded by adequate agreements. Governor Morley, in a statement to MODERN IRRIGATION, asserts: "I am very hopeful of the ultimate ratification of the Colorado River Compact, which offers the most logical solution of this whole problem."

MODERN Irrigation
The Magazine of Applied Hydraulics



Volume 1 OCTOBER, 1925 Number 4

The Progress *of* Irrigation

THE REVEREND Mr. Malthus was a wise man. In addition to being a student of theology he knew several important things about poltical economy, and in what we now call the Malthusian law, or theory, he postulated: that population tends to increase in *geometrical* proportion (continually doubling), while the means of subsistence grows only arithmetically, and, as a consequence, either population must be limited by artificial restraint or the standard of living will be progressively lowered.

Malthus foresaw impending disaster for the increasing population of Europe. But his gloomy forebodings were not realized. New continents opened up, and the means of subsistence outstripped the most prolifically increasing population. His premises were right, but he could not foresee at the beginning of the nineteenth century, what was to be accomplished toward making man a more efficient unit of production, and in expanding the resources of the world.

The Malthusian law still operates. Population grows more rapidly than the normally increasing means of livelihood. But as population grows, men have a way of finding new land to till, new crops to raise, and new means of obtaining enough to supply the increasing family of mankind.

Those who look askance on the advance of irrigation frequently commit the fallacy of assuming that the world is static. It is not static, but dynamic. Especially is this true of the great west, which has exceeded the most sanguine visions of its pioneers, and continues to amaze even those most familiar with it.

THE UNITED STATES of today, with a population of 115,000,000, is not the United States that justifies the continual progress of irrigation in all parts of the west. But it takes years to bring big projects into being, and more years to make them productive. It is the United States of the future that these developments are being built to serve—the 150,000,000 mouths that will be demanding bread and meat in another quarter of a century.

The West, particularly, must be judged not by what it is, but by what it will be. In every part of the west population increases faster than the average for the country at large. Food products produced on irrigated land were once com-

pelled to find their market in the eastern centers of population exclusively, but as the cities of the Pacific Coast and northwest continue to grow, they form centers of demand that must be supplied. Consider, for instance, Los Angeles' growth to the status of a great city, over a span of only a few years—and still going on. Around the metropolitan center more and more land is being withdrawn from agricultural use and settled by an urban population. Thus as the demand grows the supply is diminished, and irrigation enterprises, to enlarge the farming acreage on which cities must depend for their existence, are increasingly in demand.

PRESIDENT COOLIDGE, speaking on reclamation, has said: "Lay your plans for twenty years in advance. The population of this country is increasing very rapidly. The fertility of the older farms is being exhausted. We will need that new country to furnish food and produce wealth for the people of the United States."

Irrigation is one of the chief economic factors that can knock the Malthusian theory into a cocked hat. It means new wealth, new resources, new land for settlement, new life for many.

Irrigation enthusiasts of the state of Washington, protesting against the recent unfavorable report of the commission which investigated the Columbia Basin project, base their objections on this expected increase of population. As told in another part of this issue, some of them desire immediate development in spite of the report's decision that the construction of the project is not yet demanded by local or national conditions, and will make a fight before Congress to secure it. Almost every voice, however, is united in an expression of confidence that it is a matter of time, only, until the growth of the west will require it, and this mammoth undertaking will be a reality. The progress of irrigation is irresistible and inevitable.

AS THE SUMMER draws to a close, and the period of maximum construction activity in the irrigation country is ushered in, large developments are going forward in practically every western state.

The Nevada Irrigation District, Nevada County, California, has purchased important water rights which have been in litigation, and is expected to proceed immediately with the construction of the first unit of a six million dollar project which will eventually irrigate 140,000 acres of land.

Land appraisal work has been begun on the Kittitas High-line Canal, in Washington, and actual construction is expected to be begun early in 1926. Engineering data for the construction has been completed, an appropriation of $750,000 has been made by Congress to start the work, and the big project may be said to be fairly under way. Its construction cost is estimated at $9,000,000.

Commissioners of Jefferson County, Washington, have applied for water rights to make possible the irrigation of 60,000 acres of land, and the development of power and municipal water supply for Port Townsend at an estimated total cost of $8,000,000.

Similar developments, of lesser magnitude, are reported from all parts of the west. New irrigation districts are being formed, and older ones are beginning new construction work. The advance of irrigation proceeds without interruption, and a temporary delay in one section is offset by rapid forward strides elsewhere.

WELCOME rains in Colorado and Arizona during the late summer gave to irrigation districts which depend on the Colorado River for their water supply assurance of a satisfactory year. The Imperial Valley will especially be benefitted by this timely rainfall. Cotton acreage in the valley this year is 13,500 acres less than it was in 1924, and the chief reason for the drop was the fear of a disastrous water shortage. Cotton in the valley was pronounced in better condition than for several years past, and with the Colorado flowing at peak in September, there was good cause for optimism among the growers. Last year at the first of September water was being allocated to acreage and fear was felt that it might be necessary to cut off irrigation water altogether in some places.

LOS ANGELES means to keep her municipal water supply a step ahead of its needs. A program involving the drilling of many deep wells and the installation of a mile-long filtration system, to cost, ultimately, more than a million dollars, was recently announced by the municipal water bureau of that city. Much of Los Angeles' phenomenal growth has been ascribed to the fact that it planned years in advance for its water supply, and evidently that same policy is to be followed in the future. Los Angeles hopes ultimately to bring water for domestic use from the Colorado River, but in the meantime it will not neglect other sources of development. The Los Angeles "River," considered a great joke by those who see only its dry surface, has really a large and reliable underground flow which remains the principal source of the water supply for a large portion of the city, and the supply from it will be greatly increased by the work now contemplated.

MODERN IRRIGATION is deeply appreciative of the fact that its undertakings on behalf of irrigation have been recognized in so signal a manner by the Western Irrigation Equipment Association, which organization, on September 11th last, conferred its first Honorary Membership upon a representative of the magazine and, by special resolution, designated it as the "official publication" of the Association. We esteem these honors the more highly because they have been conferred without any solicitation or overtures whatsoever upon the part of MODERN IRRIGATION, *or by anyone acting for, or with the knowledge of, the publishers. We can acknowledge them properly, at this time, only by saying that we are deeply gratified at the action of the Association, and will continue in an earnest effort to merit the approval and support of this and every organization that is sincerely working for the advancement and welfare of Irrigation and its allied hydraulic industries.*—THE PUBLISHERS.

C. F. ZIMANSKY
Re-elected as President of W. I. E. A. at annual meeting.

Western Irrigation Equipment Asociation Honors *Modern Irrigation*

Resolution Recognizes the Magazine as "Official Publication" and Confers Honorary Membership Upon Executive of the Company

TANGIBLE recognition of the work which MODERN IRRIGATION has undertaken, and is beginning to accomplish already in the western hydraulic industry, was accorded in a graceful way by the Western Irrigation Equipment Association at its annual meeting, held at Sacramento, on September 11, 1925.

Two very high compliments were paid to the magazine. Owen Brown, president of the Petroleum World Publishing Company, publishers of MODERN IRRIGATION, was elected an honorary member of the association—the first man to be so honored since the founding of the organization. By action of the executive committee, MODERN IRRIGATION was designated the official publication of the association. The following excerpts from the records give an account of the proceedings in official language:

FROM THE minutes of the meeting of the Executive Committee:

"Upon motion made by Jos. H. Cox, and seconded by J. J. Merritt, MODERN IRIGATION was adopted as the official publication of the Western Irrigation Equipment Association."

"It was unanimously agreed that, on account of the support given us by MODERN IRRIGATION, the W. I. E. A. should tender the chief executive of that timely publication an honorary membership in the association."

"Upon motion by Jos. H. Cox, seconded by J. J. Merritt, it was decided to send a telegram to Mr. Owen Brown, president of the publishers of MODERN IRRIGATION, asking permission to present his name before the open meeting of the association as a candidate for Honorary Membership."

From the minutes of the annual meeting:

"It was moved by Jos. H. Cox and seconded by C. A. Utley that, in accordance with Article 5, Section 3, of the Constitution of the Association, an honorary membership in the Western Irrigation Equipment Association be conferred on Mr. Owen Brown, president of MODERN IRRIGATION. Motion carried."

BOTH of these actions by the association came to the magazine and its publishers as a complete surprise. Neither had been anticipated nor solicited; and not until the receipt of official notice from C. A. Utley, secretary of the association, did the office of the publication know what had been done by the W. I. E. As. In a letter to Mr. Brown, Secretary Utley says:

"This is the first honorary membership that the Association has ever conferred, and you were chosen for this honor in recognition of the way in which you and and your magazine have 'put your shoulders to the wheel' in the interest of irrigation."

The section of the association's constitution governing the conferring of honorary membership provides: "Honorary membership may be conferred on unanimous recommendation of the Executive Committee and by vote of the Association, at any regular meeting, upon

JOS. H. COX

Vice-President of the Frank J. Kimball Company, who was chosen to succeed himself as vice-president of the Association.

distinguished designers, inventors, engineers, or others who have rendered signal service in promoting the knowledge of irrigation and hydraulics, or the adoption of more improved methods."

MODERN IRRIGATION'S interest in the work of the W. I. E. A., as manifested in the past, has been based upon its expressed desire to co-operate with any and every organization having for its purpose the advancement of irrigation and the several related hydraulic interests. It has been rendered with the belief that the equipment men's organization is accomplishing a service of distinct value to the industry as a whole, in the district in which it is active, and in accordance with its expressed purposes, one of which is thus stated by its constitution:

"To conduct a campaign of education that the buying public may be made fully aware of the possibilities of our great state under intelligent and thorough irrigation; of the superiority of artificial irrigation to uncertain rainfall and climatic conditions; and of the large returns that proper irrigation equipment may be made to yield."

THE PUBLISHERS of MODERN IRRIGATION have made it plain, in other issues, that the magazine is an independent agent, not controlled in any way by an institution, organization, or individual, but working shoulder to shoulder with every agency whose purposes and efforts run parallel to its expressed objectives. It expects, as it demonstrates its usefulness, to receive the co-operation and endorsement of all such organizations as have common interests, purposes and ideals, and the cordial endorsement of the Irrigation Equipment Association, expressed by its designation of the Magazine as "official publication," is one very concrete indication that its expectation is justified.

Mr. Brown, president of the Petroleum World Publishing Company, is the man whose interest in irrigation affairs led him, some four years ago, to a recognition of the opportunity for a magazine such as MODERN IRRIGATION — one which would serve the great industry which is concerned, directly or indirectly, with the practical application of hydraulics to all problems of water supply. His experience in successful publication work gave him at once an insight into the needs for such an enterprise and the opportunities awaiting it. He has accepted with pleasure and thanks the honorary membership extended by the association, on behalf of MODERN IRRIGATION, and has pledged the magazine to continue the work which has justified that signal recognition.

Equipment Association Holds Annual Meeting at Sacramento

Zimansky, Cox and Utley Re-elected to Head Organization Another Year

BY H. ELLIOTT TAYLOR

PRESIDENT C. F. Zimansky will head the activities of the Western Irrigation Equipment Association for another year, as the result of the election held at the annual meeting in September. Joseph H. Cox and C. A. Utley retain their posts as vice-president and secretary, respectively, and J. J. Merritt will act as treasurer. The newly elected executive committee includes J. E. Lundy, V. E. Nittinger, J. T. S. Clark, P. L. Nourse, A. M. Frost, and C. B. Noyes.

A goodly percentage of the membership was present at both the business meeting, which was held at Sacramento during fair week, and the evening banquet at a Sacramento hotel

THE annual report of the president formed the basis for the discussions which featured the business meeting. It briefly reviewed the career of the Association during the past year and laid broad plans for the coming year's activities.

The following paragraphs are some high lights from his message to the organization:

"In general, the methods of the trade average higher, the membership is better informed as to the needs of the trade—more nearly agreed as to policies, and better acquainted with the personality and aims of each other.

"A more satisfactory contact has been established with the state government, the managements of the state and Fresno fairs, the power companies and—in a lesser degree—with the public.

"During the year there has been a net gain of members.

"We have now reached a considerable degree of agreement on the subject of well testing and return of used equipment, but still have pending such important matters as the standard guarantee, sales contract and switchboard, on all of which some progress has been made and more rapid progress is probable.

"The major problems now confronting us are: curbing the cut-throat price war, and increased publicity for our work, aims and ideals.

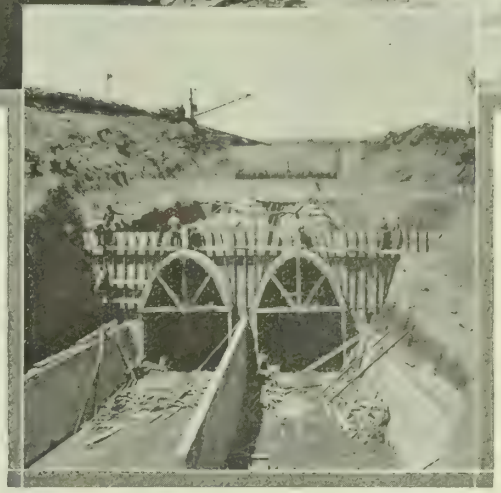
"A reasonable profit is legitimate, ethical and absolutely necessary for the continuance of the industry.

"Increased publicity is one of our

(*Continued on Page 49*)

C. A. UTLEY

Field Engineer for the Pelton Water Wheel Company, re-elected Secretary of the Association at the annual meeting.



Dallas Builds for a Greater City's Needs

Garza Dam Will Provide Water For Municipal Use and Irrigation

By R. A. THOMPSON
Water Reservoir Engineer

ABOVE—*The Concrete Spillway, 560 feet in length. It will contain about 24,000 cu. yds. of concrete.* BELOW—*Concrete conduits built to handle flood water during construction and later to pass stored water to Dallas.*

BECAUSE Texas has no mountain sources of water supply of consequence, dependence must be placed in the normal flow of streams and the impounding of flood waters to provide for municipal requirements, irrigation, etc. While some artesian supplies are available, these are limited both in extent and productivity. Flood water is abundant and there are many favorable sites for storage dams on the principal streams.

A very marked movement is under way at the present time, supported by the state and other conservation agencies, to locate and develop a number of large reservoir sites for purposes of flood control, municipal supply, power and irrigation. The Wichita Falls project recently completed at a cost of $4,500,000 is the pioneer enterprise of its kind in the State and not only provides for the needs of that city but will furnish ample water for irrigation of more than 100,000 acres in the Wichita River valley.

PHENOMENAL growth in the population of Dallas, Texas, which increased from 138,000 in 1920 to 210,000 in 1924, has demanded a very substantial enlargement of the municipal water supply to meet both present and future needs. An exhaustion of the storage in the present reservoirs, which amounts to about seven billion gallons, has already been threatened upon several occasions of extended drought.

In 1923 a bond issue of $5,000,000 was voted to provide an additional water supply. After careful examination of all practical sources it was decided to construct a storage dam on Elm Fork of Trinity River, about 30 miles northwest of the city at a site near the town of Garza. With the available funds it was found that a dam could be built to form a reservoir of capacity 193,000 acre feet, or 63,000,000,000 gallons, which would amply provide for the needs of the city until its population reached 700,000. The drainage area is 1100 square miles, upon which the annual rainfall averages about 35 inches.

THE GARZA Dam, now being built by the city of Dallas, is of the hyrdaulic earth fill type, about 2 miles long and of a maximum height of 80 feet. Contract was let for the construction in August, 1924, and the structure is at present (September, 1925) about 50 per cent completed. Its cost will approximate $3,250,000. The lake formed will cover an area of about 11,000 acres at spillway crest—sea level elevation 525.

The embankment will contain 2,000,000 cubic yards, all of which, with the exception of about 150,000 square yards will be placed with an electrically operated suction dredge having a capacity of about 200,000 cubic yards per month. The 20 inch dredge pump is directly connected to a 1600 H.P., 2300 volt alternating current motor which discharges through 20-inch welded steel pipe on to the dam.

MATERIAL for the fill is obtained from borrow pits immediately above the dam and is a stiff alluvial clay with occasional pockets of strata of sand and gravel. This clay, while difficult to excavate and at times reaching the fill in the form of balls from ⅛ to 10 inches in diameter, is well suited for the purpose. The levees on each side to hold the successive layers or lifts of embankment average from 3 to 4 feet thick and are built up with 2 P. and H. drag lines with material from the center as the work progresses. A temporary dam was built across the channel, prior to the completion of the conduits, to form a lake within which to launch and float the dredge.

The dam is 30 feet wide on top and will carry a graveled highway. Both upstream and downstream slopes are 3 to 1, the latter, however, will be modified to admit of two 8-foot berms being placed 20 and 50 feet respectively below the top of the dam. The drainage on these berms will be led into concrete catchment basins which will discharge through 8-inch tiles well outside of the toe of the slope.

The upper slope of the embankment will be protected with 12 inches of hand laid Stringtown, Oklahoma, chert lime-

stone up to elevation 507.5. From this point 18-inches of limestone will be used up to elevation 532.5 and thereafter 12 inches to top of dam at elevation 540. All riprap will be underlaid with an 8-inch gravel blanket.

ALONG the center line of the dam for its entire length a core trench has been excavated to and into the impervious shale beneath except across the river valley where the shale was too deep to reach with an open trench. Here the excavation was made from 25 to 30 feet deep to ground water level and in the bottom a single line of interlocking steel piling (Carnegie Section M-104) weighing 35 pounds per square feet was driven to shale. The piling varied from 14 to 45 feet in length and was permitted to stick up a minimum of 6 feet in the trench and was subsequently encased in the puddled core placed by the dredge. A total of 121,925 square feet (2134 tons) of piling was driven.

The core trench, usually 12 feet wide at bottom with side slopes of 1 to 1, varying from 6 to 33 feet in depth, was excavated with an electrically operated Bucyrus Class 24 drag line, having a 5-yard bucket and a 100-foot boom. This machine was worked in 8-hour shifts and averaged about 200 cubic yards per hour.

To control the flood water during the construction period, reinforced concrete conduits have been built in a notch cut in the shale bank immediately south of the river channel. These consist of two oval shaped barrels of a total length of 465 feet, including inlet and outlet, and having a vertical (major) diameter of 19 feet and a horizontal (minor) diameter of 14 feet. The bottom of the conduits are at the same elevation (460) as the present river bed. They contain about 4,800 cubic yards of concrete and will discharge 12,000 second feet under a 44 feet head, which will be sufficient to carry normal floods.

AFTER completion of the dam, in order to pass the water from the reservoir down the river channel to the settling basins and filtration plant of the city below, double concrete plugs will be placed in each conduit barrel and through these will be installed in each barrel, 2 lines of 48-inch cast iron pipe. The discharge through each pipe will then be controlled by two 48-inch single gate valves. Also in one barrel one line of 18-inch pipe will be installed having two 18-inch valves. These valves will be hand operated on top of the dam through a concrete tower extending from the gate chamber below.

On the high ground a few hundred feet south of the river channel a concrete spillway is under construction, 560 feet long and of the O. G. gravity type section. The crest is at sea level elevation 525, 15 feet below the top of the dam. The main body of the spillway is from 20 to 25 feet high and rests on a stratum of hard blue impervious shale. It is connected with the concrete apron below with a slab 4 feet thick and resting on a slope at the top 2¾ to 1, and increasing to 1¼ to 1. The floor of the apron is at elevation 457, 3 feet lower than the river bed and 68 feet below the spillway crest. It is protected on the outer edge with a concrete cut-off wall extending 10 feet into the shale.

R. A. THOMPSON

MR. THOMPSON is a consult-engineer who covers a big field, both technically and geographically. He is a member of the water-reservoir engineering firm of Nagle & Thompson, Dallas, and of the recently formed firm of Thompson and Butler, Consulting Engineers, San Francisco. Through his connection with the Dallas firm he has been in charge of preliminary investigations and construction work on the Garza Dam.

The highway will be carried over the spillway on four 139 feet steel spans.

At the extreme south end of the dam are two low sections in the ridge, one about 600 feet wide and the other about 1,000 feet wide, 5 and 4 feet below the spillway crest respectively, through which the flood water will be discharged in the case of unusual and extraordinary rises. The discharge of the service spillway at elevation 535, 5 feet below the top of the dam, will be 58,000 second feet and this approximates the greatest flood of record on this drainage.

THE GARZA dam will be completed early in the summer of 1926. A lake will be formed 11 miles long and averaging 1½ miles wide and 18 feet deep. When a greater storage is desired the capacity of the reservoir can be increased from 63,000,000,000 to 70,000,000,000 gallons by the installation of 2 feet flashboards on the service spillway crest.

The reservoir basin will submerge highways to such extent that the reconstruction of about 25 miles of road will be required to lead them over the dam at the south end of the reservoir and over a causeway to be built near the north end. About 30 miles of telephone line must be rebuilt and some 2 miles of natural gas main relocated. The main line of the Texas and Pacific Railway which crosses the north end of the reservoir will be required to be raised about 5 feet for one mile across the valley to place it above the probable high water lines.

The project has been carried forward under the present administration of the City of Dallas of which Louis Blaylock is mayor. Both the preliminary investigations and the construction work are in charge of J. C. Nagle and R. A. Thompson as chief engineers. O. N. Floyd is principal assistant engineer and T. C. Shuler, resident engineer. The contract for the entire construction was awarded to the W. E. Callahan Construction Company of Dallas, Texas, general contractors. The Puget Sound Bridge and Dredging Company of Seattle, Washington, has the sub-contract for the hydraulic fill.

The illustrations appearing on the preceding page give just a hint of the magnitude of the construction work which is now going on. At the left end of the larger picture working on the inclined surface of the spillway, may be identified three tiny figures—workmen whose infinitesimal proportions in the photograph are in interesting contrast to those of the task on which they are engaged. In the lower photograph are shown the two oval conduits which are now serving to handle flood water, and after the completion of the work will pass stored water from the reservoir down the river channel to the filtration plants and settling basins of the city. These conduits required 54,000 cubic yards of excavation.

"The Columbia River Basin, under the program of development on which your Inland Empire is bent, will be made the seat of a greater, incomparably richer and more varied empire of industry and agriculture, than was the Egypt which served as the granary for imperial Rome."—WARREN G. HARDING.

ABOVE—*The proposed dam site, where an impounding lake will be created if the plans of the project are eventually worked out as contemplated by the Columbia Basin Irrigation League.*

BELOW—*The Washington desert. A typical desert spot in Washington, illustrative of the sort of land which the League seeks to reclaim to productivity and fertility by water from the Pend Oreille River.*

This is the "Scheme of Development Upon Which the Inland Empire is Bent"

A Statement of the What and Where of the Proposed Columbia River Basin Project

By FRED A. ADAMS

Secretary, Columbia Basin Irrigation League

THE COLUMBIA Basin Irrigation League, composed of representative business men of the four Pacific Northwest states—Oregon, Washington, Idaho and Montana—is, with government and state approval, urging the development by irrigation of approximately two million acres of arid land in the state of Washington.

The area proposed to be irrigated is a great pear-shaped block of land embracing about 3,000 square miles in the counties of Grant, Adams, Franklin and Walla Walla. Its western boundary is formed by the Columbia River and a portion of its eastern boundary by the Snake River. First proposals to utilize the waters of the Columbia by pumping lifts were later discarded in favor of a gravity system. This was found to be feasible by bringing the water of the Pend Oreille River in Idaho by large concrete lined canals to the area to be irrigated.

ESTIMATES of the cost and engineering work contemplate a complete and permanent project. There will be 40 miles of natural and artificial lakes, 34 miles of tunnels and 60 miles of concrete lined canals and steel syphons.

To reclaim this vast area it is proposed to store the drainage waters coming from 25,000 square miles in the northern Idaho and western Montana watershed of the Rocky Mountains. Initial storage will be obtained in two large lakes in Idaho—Pend Oreille Lake and Priest Lake.

The point of diversion for water is on the Pend Oreille River at Albany Falls, 50 miles northeast of Spokane.

The average annual flow of this river is 19,000,000 acre-feet—larger than the mean annual flow of the Colorado River.

After six years of continuous investigation by government, state and private agencies the Columbia Basin project was found to be both economically and physically feasible by federal engineers. The report of this board has just been submitted to the Columbia Basin Irri-

gation League trustees. The engineers' report concludes that:

The irrigation of 1,883,000 acres of first class agricultural land is feasible by use of a gravity system, supplemented with short pumping lifts.

AMONG important conclusions reached by the board of federal engineers are:

"The board is convinced from its own study and a review of all previous reports that the project is physically feasible. That the cost of land and water will be less than on many projects where the land is held in private ownership. That it is less than that of most irrigation districts privately financed. That the project is as attractive economically as the better projects already built and those recently approved by the United States Bureau of Reclamation."

Hervey Lindley, of Seattle, president of the league, at a meeting in Portland recently said:

"By bringing the water of the Pend Oreille River to the arid lands of the Columbia Basin, this great project in the state of Washington, when developed, will add $180,000,000 a year to the productive wealth of the nation.

"It is conservatively estimated, using as a base the wholesale value of manufactured products shipped to various irrigated sections in the Pacific Northwest, that the Columbia Basin's annual purchasing power for manufactured products will be from $150,000,000 to $160;000,000."

IN A PROJECT of such stupendous size as the Columbia Basin adequate transportation facilities are necessary. Efficient transportation facilities already exist on the project.

Five main line railroads, four of which are transcontinental systems, traverse the area with a total trackage of 498 miles. Transportation outlets are also afforded by the Columbia and Snake Rivers to the Pacific ocean. Many markets lie at the door of the irrigable area. Portland, Tacoma, Seattle and Spokane are but a few hours' distance by railroad. There is direct connection to Canada and California. The water outlet to coast ports places the Oriental and Alaskan markets within reach, while the Panama Canal will enable the Columbia Basin producer to market his products on the Atlantic coast expeditiously and profitably.

"Every effort is being made to prevent speculation in these lands," says Mr. Lindley. "If the Columbia Basin project is to attain the maximum ultimate measure of success, settlers must get tracts at present land values plus the cost

(*Continued on Page 41*)

Oregon Irrigation Congress in Successful Meeting

IRRIGATION finance and the political side of irrigation and reclamation developments in Oregon were the dominant topics at the Oregon Irrigation Congress, meeting in its fifteenth anniversary session at Grant's Pass, Oregon, October 5, 6 and 7.

James M. Kyle, president of the Congress, opening the convention of irrigationists, criticized the policies of the national reclamation bureau, and emphasized the importance of settling the arid lands of the state.

JAMES M. KYLE

"If irrigation is to grow and prosper," declared Mr. Kyle, "it must be through the peopling of our arid lands."

Irrigation, he asserted, is not a failure; but in some cases financial policies have been mistaken, and refinancing is required. He advocated irrigation in the Willamette Valley, opposed the proposal for a $40,000,000 bond issue for public power development, and the state law guaranteeing interest on irrigation bonds of approved projects, suggesting a fund of one million dollars for state aid and direction of irrigation on state projects, but opposed state aid on federal projects.

He vigorously condemned land speculation as an undesirable feature of irrigation developments, saying: "In so many cases sagebrush land that was not worth over $2.50 up to $10 an acre was sold as high as $200 and in a few cases as high as $500 per acre, and then the settler expected to pay in addition the cost of the water. Is there any wonder that some settlers could not make good?

"The time has come when something must be done to refinance some of our projects. Let us get some of the big men of the state interested in this. Let them get together men trained in financing large undertakings, give them all the assistance needed, let them work out a program—then let everyone get behind it and put it over, cut out all the water except that which is put on the land, for it is only water that will grow crops."

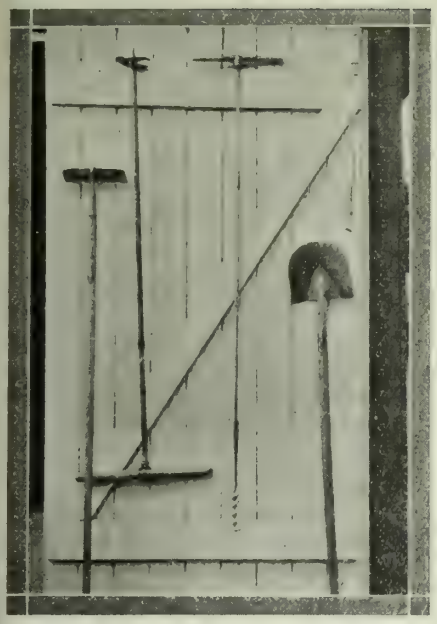
Senator Charles L. McNary, on the opening day of the convention, delivered a speech in which he scored the Reclamation Bureau's administration of reclamation projects in Oregon.

ON THE SECOND day of the congress, the visitors were taken in a great caravan on an inspection tour of the Rogue River Valley to observe the results of irrigation there. The delegates were guests of Grant's Pass at an evening banquet at which Governor Pierce of Oregon was the principal speaker.

Visitors from many parts of the west attended the Congress. Among the speakers were George C. Jewett, president of the Federal Farm Loan Bank of Spokane; John Dwight Neale, of San Francisco; W. W. McLaughlin, of Berkeley; Hervey Lindley, of Seattle, president of the Columbia Basin Irrigation League, and several other prominent authorities on irrigation from outside of the state.

Oregon irrigationists who addressed the congress included President James M. Kyle, of Stanfield; Secretary Walter E. Meacham, of Baker; Rhea Luper, State Engineer; H. M. Chadwick, Assistant State Engineer; W. L. Powers, of the Oregon Agricultural College; Senator McNary, Senator Stanfield, I. L. Patterson, George Wilbur, Marshall N. Dana, Franklin T. Griffith, and others.

One of the interesting developments of the Congress was the sentiment in evidence in opposition to the Oregon law which guarantees the interest on irrigation bonds of approved projects.



Try this on your barn-door. One irrigator finds that having his tools thus arranged means convenient accessibility, and a continual reminder that a soil moisture test can hardly be made too often.

Are *Your* Orchard Trees Getting *Optimum* Moisture?

An Expert Discussion of Factors Influencing Soil Moisture Control in Fruit Growing

By MARVIN B. ROUNDS

Acting Farm Advisor, Los Angeles County, California

OF THE SEVERAL fundamentals recognized as most important in the production of fruits none is more important than proper soil moisture regulation.

Production and profit are probably governed more by the water supply than by any other one factor. When conditions are such that the plant or tree is not furnished with a constant supply of available moisture, wilting takes place, the tree declines—and finally dies, if this condition is of long duration.

The water content of plants is about 75 per cent or more. Some parts of the plant, such as the fruit, contain more moisture than other parts. Leaves and recent growth contain more water than old wood. Water is constantly passing off from the green portions of the tree, especially the leaves. The tree is consequently receiving water, and, if rigidity is to be maintained, water must be supplied from the soil through the roots. Further, water must be constantly supplied to the tree in order to transport mineral material from the soil to the leaves to be made into plant food. Not only does this mineral matter go into the food products manufactured in the tree, but some of the water itself furnishes a portion of the organic compounds manufactured, and is necessary as food to the plant.

Water which passes up from the roots into the several tissues of the plant is usually in excess of that necessary for the use of the tree, and it is passed off through the leaves and other green portions into the air. Transpiration, as this process is called, is necessary to the tree also to regulate the temperature of the tissues of the tree. Several factors are involved which tend to decrease and increase the transpiration rate. Three important factors are temperature, humidity and velocity of wind. These three factors involved in transpiration frequently govern the kinds of crops which can be produced and the varieties of certain plants which may be grown in a certain locality. Plants adapt themselves to the atmospheric or climatic conditions. Some varieties of plants have leaves which differ greatly from others in that they can withstand certain atmospheric conditions which increase transpiration, giving off very little moisture when the giving off of excessive moisture would mean the death of the plant. Some plants are adapted to humid climates and have leaf surfaces which transpire a great deal of moisture. Rates of transpiration vary, being much greater in interior sections of the west than in coastal regions.

IT IS ESTIMATED that on the average about 500 parts of moisture are required to produce one part of dry matter. Of course, there is considerable variation with respect to this figure in plants, more succulent plants such as alfalfa and cover crop plants requiring much more than this. If we use this figure 500 as approximately the number of parts of water required to produce one part of dry matter in orchard crops, it has been estimated that for a nine year old peach orchard, 11-acre inches of water evenly distributed would be required for growth and the production of fruit. This does not take into consideration any loss through run off, evaporation from the surface, or too deep penetration, but considers only that used by the tree. Further, it has been estimated that about one-third of the water actually applied to the soil becomes available, and that the balance is lost. This peach orchard then would require an application of 33-acre inches of water to fulfill all requirements. Probably a mature citrus orchard would require even a greater application.

OBVIOUSLY, an adequate supply of irrigation water should be obtained and an effort made to conserve as much as possible of that applied. How can conservation be accomplished? In general: First, by having the surface soil in the proper physical condition; second, by proper distribution of moisture throughout the root feeding area; third; by preventing too deep penetration.

To be specific, proper physical condition of the surface soil means that it should be loose with no plow sole or hard stratum just below the surface. When this condition exists water will be more quickly absorbed and proper penetration accomplished.

Proper distribution is effected only when the whole root feeding area of the soil is moistened. In many soils, if water is applied to only one-half of the soil surface, not much more than one-half of the soil obtains water. This limits the root system because of the fact that roots cannot develop and obtain nutrients in a dry soil. An even distribution of roots is the ideal.

If water is applied in amounts so that it penetrates the soil much below the feeding roots it is wasted for it will not come up again and become available to the tree.

WATER in soil is recognized in three forms; free, capillary and hygroscopic. Free water is that which when applied passes down through the soil mass by force of gravity, wets all soil particles and finally is absorbed or passes away in the country drainage. Capillary water is that which is absorbed by the soil and remains as a thin film clinging to the soil particles. Hygroscopic water is that which is retained by the soil when it is air dried but varies from 2 to 10 per cent of the weight of the soil.

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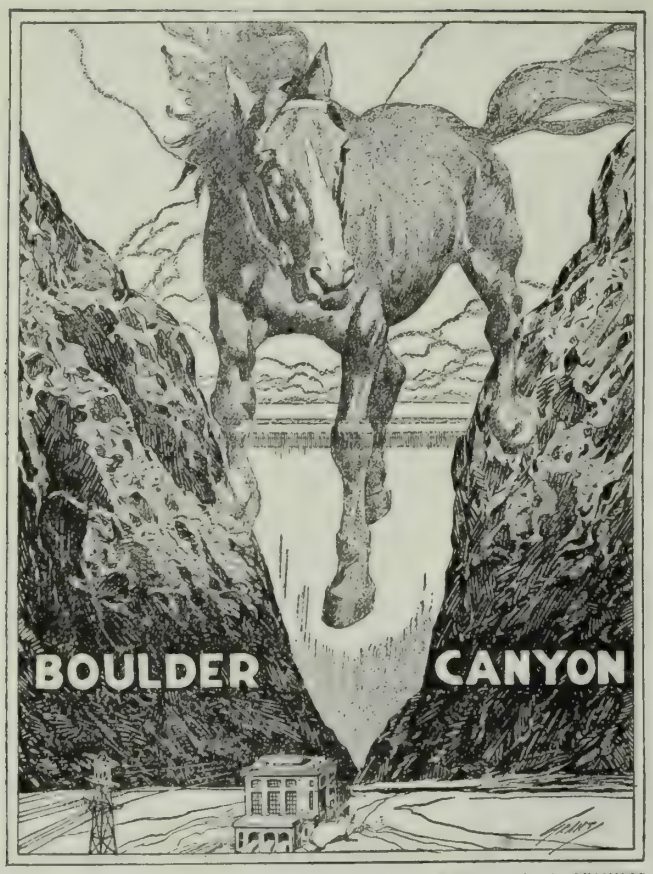

GRANT IN L. A. EXAMINER.

This newspaper artist visualizes, in graphic style, the immense power of the Colorado River, awaiting development. The Examiner is a supporter of the much discussed Swing-Johnson Bill.

Governors Declare Attitude of Upper Basin States

Demand Protection of Rights Before They Will Consent to Development of Lower River

SENATORS comprising the sub-committee of the Senate Committee on Irrigation and Reclamation, which will meet in October to make a close and intimate study of the problems of the Colorado River Basin, pursuant to authorization from Congress, will have something definite to masticate—and another kink to iron out of an already complicated situation—in the shape of the joint resolution promulgated by the governors of Colorado, New Mexico, Utah, and Wyoming at their recent all-day conference.

The attitude of the four upper-basin states is supposed to be set forth in the statement of the governors' conference, and its import was a declaration of opposition to any developments on the lower Colorado for purposes of "flood control, power development, or any other uses", until the interests of the upper states are protected by compacts between all the states interested.

The joint resolution was addressed by the governors "to the people of Colorado, New Mexico, Utah and Wyoming", and begins by a general statement of the situation on the Colorado River and an explanation of the reasons why the statement is demanded. It declares:

"The Colorado river rises in the states of Colorado, New Mexico, Utah and Wyoming. The are arid and the first use of the waters of the river is essential to the growth, development and the general welfare of our states. The construction of enormous works on the lower river which might give rise to assertions of claim to monopolistic and exclusive use of our waters, would be destructive of our institutions and inimical to our welfare unless adequate protection is provided in advance of such construction. The Colorado river compact affords this protection. It protects the future development of the upper states without injury to the states of the lower basin and permits immediate construction of necessary flood control works on the lower river without resultant injury to the upper states. Its provisions are fair and just. Our legislatures ratified the compact, but for reasons of interstate comity, we remained silent that the states of Arizona and California might conclude their discussions. But conditions now demand that we speak lest our silence be misconstrued."

THEN FOLLOWS a chronological summary of the attempts of the Colorado River states to reach an agreement which would permit the development of the river for the primary purpose of flood control. Beginning with the disastrous break-over of 1905, when the Colorado flowed through the Imperial Valley into the Salton Sea, and following through the various meetings, conferences and deliberative assemblies which have taken place since that date, the resolution touches briefly on the important conferences at Salt Lake City in 1919, in Los Angeles and at Denver in 1920, at Riverside in 1921, at Denver in 1921, at Washington in the same year, and the meeting at Santa Fe, New Mexico, on November 24, 1922, when the Colorado River Compact was drawn up.

"The failure of the Arizona legislature to approve the compact prevented flood control," says the statement. "The states of Colorado, Nevada, New Mexico, Utah and Wyoming, by action of the 1925 sessions of their legislatures, offered to avoid further delay by the concurrent enactment of uniform legislation by the six ratifying states to provide that the compact should be effective between the states of California, Colorado, Nevada, New Mexico, Utah and Wyoming, when the six named states should have enacted such legislation, without awaiting action by Arizona. But the state of California failed to agree, thus preventing the compact from becoming immediately effective, thereby again delaying construction of flood control works.

"The states of the upper basin, with promptness and without reservations, have passed every measure essential to make the Colorado river compact effective and flood control and other development immediately available. But our proffers of co-operation and good will have been ignored; our silence has been misconstrued; threats of groundless litigation against us are being made to secure the construction of enormous works along the lower river without our consent and without regard to our future necessities and the welfare of our commonwealths.

WE STAND now, as we have consistently stood throughout all negotiations, for prompt action that will provide adequate flood control in the lower basin of the Colorado river, but, as an economic proposition, such flood

(Continued on Page 53)

Equipment Dealers Face Knotty Problems In Handling Used Pumps

Committee of Three Association Members, Appointed to Investigate Matter, Advocates Strict Limitations on Both Manufacturers and Retailers

By HUGH CRANE

USED pumps, and used equipment in general, bid fair to become the same sort of a disturbing factor in the irrigation equipment industry that the used or second-hand car has proved to be in the automobile industry. It is a problem of importance not only to the manufacturer who makes the pumps, and the retailer, who sells them, but to the irrigator, who uses them, as well. Just as the consumer in the automotive world is concerned in having the sale of used cars regulated by some reasonable and equitable restrictions, which guarantee safety to the buyer while protecting the dealer from unscrupulous competition, so the irrigator is interested in the rules—or the lack of rules—governing the return and re-sale of used equipment.

The Western Irrigation Equipment Association, of California, has determined to make a careful study of this problem, with a view to working out some solution that will afford this dual protection to both buyer and seller. E. M. Breed of San Francisco is chairman of a committee, recently appointed to investigate the whole matter, and his recommendations, as presented in the committee's report to the association, are based on many hours of thought given to all aspects of the situation.

The Committee's Report

The following is the report submitted by Mr. Breed as chairman of the committee appointed by the Western Irrigation Equipment Association to study and report on the problem of used equipment:

Mr. President, Gentlemen:

Our investigation indicates very clearly that the situation involved is not one that presents the same problems to all of our members and it is therefore the belief of your Committee that separate recommendations should be adopted by the Association as applying to dealers and manufacturers.

Obviously, it is often to the advantage of the dealer either to buy in used equipment or to make a legitimate allowance on used equipment as partial payment on new machinery. Transactions of this type undoubtedly provide a considerable source of revenue to many of our dealer members when handled on the basis of the actual value of the used equipment and not on a false value stimulated by competitors.

On the other hand, the accepting of the return of used equipment or the sale of so-called reconditioned equipment by a manufacturer in order to increase sales, can only lead to the lowering of the high standards which this Association was originally formed to maintain and a loss of faith in the products of such a manufacturer by the buying Public.

It is undoubtedly a fact that pumps which have been operated for any length of time under field conditions or which have been used in the testing of new wells where sand is always encountered, can never, even after careful reconditioning, be considered the equivalent of new equipment.

Your Committe therefore recommends that this Association go on record as being definitely opposed to any manufacturer member accepting the return of used equipment for any reason whatsoever, except where the equipment is proven to be defective or where it is found necessary to replevin the machinery.

Your Committee further recommends that the Association go on record as opposing the sale of reconditioned machinery by any manufacturer member unless the purchaser of such machinery is fully advised of the fact that the equipment has been reconditioned. *Respectfully submitted,*

E. M. BREED.

ILLUSTRATING the crux of the whole used equipment problem, as found in the irrigation country today, the following story, related by a California pump manufacturer, tells how a typical sale may be made under existing circumstances.

"Let us suppose," he says, "that Mr. Jones, a well-known irrigator of your territory—or perhaps of mine—decides that he needs a new pump. He resolves to spend no more than necessary for the equipment, and remarks to Mrs. Jones that he is going to go to town himself 'to see about buying a pump.'

"This is what he means when he says that he will *see* about one. He means that he will call on a few of the supply houses and possibly on a manufacturer, and tell each one, in a friendly and confidential way, that he is in the market for some new equipment. By such a process he will get all the prices available, select from them the lowest that he feels he can trust, and with that particular firm will open negotiations leading to a possible sale.

"Now there is nothing wrong about his manner of proceeding. But there is something decidedly wrong in the result which it leads up to, and it is something which, in the long run, will be as disastrous to the irrigator as it is sure to be to the equipment dealer.

"Jones' friend, Johnson, one of the dealers whom he approaches, makes him a price of $2000 for the outfit which he requires. Johnson wants to make the sale, and gives the prospective customer the best possible price at which he can be sure of a small profit.

"Jones meditates a little while when this sum is named, but finally says: 'Well, I'll tell you—I guess I'll take that offer if you will treat me right on my old pump. It's still in fine shape, and you fellows can clean it up and sell it for new.'

"Right here is where the saddest part of the sad story comes in. Jones hadn't mentioned a trade-in when broaching the proposition. Johnson had put his price down at bed-rock, hoping to clinch the sale. But Johnson decides, finally, to allow the customer $200 on the old equipment, feeling that the second-hand dealer will pay him that much for Jones' old pump and the fittings that go with it.

"'Two hundred isn't enough,' declares Jones. 'The Deep Well Pump Company will allow me $300; the Farmer's Friend Supply Company will let me have $360, and I have half a dozen bids that make $200 look sick.'

"There's no use detailing the rest of the transaction. Jones wants to buy from Johnson, but he wants as good terms as he can get elsewhere. Johnson

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The EDITORIAL

MODERN Irrigation

An Organized Voice for the Forces of Agriculture and Industry Which are Primarily Dependent upon Irrigation.

Published Once a Month

AT LOS ANGELES, CALIFORNIA, BY THE

PETROLEUM WORLD PUBLISHING CO. *Editorial and Executive Offices, 626 South Spring Street, Telephone Broadway 3262.* Branches: SAN FRANCISCO—447 SUTTER STREET, *Telephone Garfield 2772;* H. E. TAYLOR, *Manager.* CHICAGO—1163 MONADNOCK BLDG., *Telephone Wabash 8855;* JOSEPH E. O'CONNOR, *Manager.* NEW YORK—503 FIFTH AVENUE, ROOM 308, *Telephone Vanderbilt 8753;* WERNER HAUPTLI, *Manager.*

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Executive Editor

By Annual Subscription in the United States and possessions, $2.00; Foreign, $2.50; Single copies on sale in the irrigation country, 20 cents. In ordering change of address, give both the old and the new address. Allow ten days for re-entries on the subscription list. Advertising rates and circulation data upon request. Checks should be made payable to Petroleum World Publishing Co.

VOL. I OCTOBER, 1925 No. 4

A Valued Endorsement

IN HIS annual report to the members of the Western Irrigation Equipment Association, President C. F. Zimansky, who was re-elected head of that organization during September, said:

"Our agreeable contact with the new and up-to-date publication, MODERN IRRIGATION, should assist us greatly; and we should assist both it and ourselves by working for its widest circulation."

Following closely upon this expression of confidence, the Western Irrigation Association, through its executive committee, took action recognizing MODERN IRRIGATION as its official publication. The membership of the association, in the open annual meeting, conferred upon Mr. Owen Brown, as chief executive of the magazine, its first honorary membership.

We should be delinquent indeed, if we were to permit these high compliments to pass without acknowledgment. MODERN IRRIGATION appreciates sincerely these fine and unsolicited testimonials to the fact that the magazine's undertakings have been launched along the proper lines, and that we are, already, beginning to accomplish some of the things which we set out to do.

To Mr. Zimansky and the Western Irrigation Equipment Association we desire to say that, to the best of our ability, we shall endeavor to deserve their continued friendship and co-operation by working constantly for the welfare of all branches of the western hydraulic industry.

Friends in a Good Cause

AN OPPORTUNITY for greater service to our industry is offered, we believe, by such action as has been taken by the W. I. E. A. The official endorsement of such organizations makes it possible for the magazine to become, in increasing truth, the organized "voice for irrigation"—which is its objective.

There are many other organizations throughout the irrigation country which are working, as is the W. I. E. A., for the best interests of the industry. Many of these, like this association, are concerned first in advancing the welfare of some particular group or in accomplishing some particular purpose; but most of them are sufficiently broad in their vision to recognize the necessity for larger co-operation with other agencies in the field and for a greater correlation between the many factors which enter into the development of the west's water supplies for "the greatest good for the greatest number."

To enumerate only a few of these representative agencies, within the confines of a single state, will indicate how many different forms of bureaus, departments and associations, there are working for irrigation in one or more of its different branches. In California alone, for instance, one may come in contact with such officially constituted federal and state agencies as the Forest Service, the U. S. Reclamation Bureau, the California Bureau of Public Works, the California Reclamation Board, the Department of Agriculture, the Agricultural Extension Service, Flood Control Councils, and the Farm Bureaus. All of these touch irrigation and hydraulic developments intimately and constructively. There are several organizations concerned particularly with the problems of conservation, such as the Conservation Association of Southern California. There are federations of irrigationists whose prime interests are the advancement of the industry, such as the California Irrigation Districts' Association and the California Mutual Water Companies' Association.

There are many special organizations formed to deal with particular problems of reclamation, irrigation or flood control, such as the Sacramento River Problems Conference. There are semi-public associations whose objectives run parallel to these at many points, such as the California Approved Land Settlement Association. There are great commercial bodies whose programs include many water-supply problems as

POINT *Of* VIEW

among the most pressing in the entire west, such as the larger Chambers of Commerce and the California Development Association. And in addition to these there are the technical associations, such as the American Society of Agricultural Engineers, the American Society of Civil Engineers and the American Water Works Association, whose regional divisions are vitally interested in many of the larger problems of irrigation.

And this is but a suggestion of the possible concert of effort that is visible in a single state. Other states have their Irrigation Congresses and Leagues in corresponding numbers.

We enumerate these simply to show that there is a great array of associations devoting their efforts to the advancement of the hydraulic industry. Every one of these has its proper place and function. And each one of them can, if it will, find a source of willing assistance and co-operation in MODERN IRRIGATION. This magazine has been established for the service of the entire industry, and to that end is ready to lend its columns to each and every one of the organizations in the west whose activities contribute to that service.

Able Allies of Irrigation

COMMERCIAL bodies such as chambers of commerce and development associations are accomplishing for irrigation some of the most important work that is being done in its interest. And this is not confined to the organizations serving the largest cities, such as Los Angeles or Portland, but is shared in by many smaller communities.

Chambers of Commerce of Ventura County, California, co-operating with the county farm bureau and agricultural extension service, recently arranged a tour on which thirty ranchers were taken into canyons in Los Angeles County, where notable conservation work has been done with check dams.

Chamber of Commerce executives of The Dalles, Oregon, recently headed a party of engineers and orchardists on a comprehensive tour of the watershed of Wasco County, as the finale to a complete survey made under the auspices of their organization, dealing with the potential irrigation resources of that section.

The Realty Board and Chamber of Commerce of La Grande, Oregon, are co-operating in planning an excursion of farmers and business men of that section into the Yakima Valley, there to see what irrigation is accomplishing.

During the latter part of September, a commercial organization of San Francisco devoted an entire week to conferences and hearings on problems of forest protection and water-supply.

All these things are suggestive of what is being done and what may be done in the interest of irrigation by organizations far sighted enough to recognize the importance of irrigation to the entire community. They illustrate how one of the industry's great problems is being partly solved—the problem of educating the public to what irrigation means.

Educating the Public

IRRIGATIONISTS have long recognized this as one of the chief obstacles to the proper protection and development of our water resources—the lack of a link between the informed man, whose contact with the practical affairs of the industry have shown him what ought to be done, and the uniformed public upon whose franchise the adoption of one course or another must often depend.

Of course, to reach the masses with the truth about this or any other subject is a hopelessly discouraging task. The "man in the street" is usually in that category, generally speaking, because he either hasn't the intelligence or interest required to understand the practical side of many matters that concern him only indirectly. But the chambers of commerce, by their wakening and increasing interest in affairs of irrigation, are welding a link between the industry and alert and thinking business men which will prove the most valuable extension of irrigation knowledge that can be gained.

The business man, no matter how he may be derided by the so-called intelligentzia, still exerts a disproportionate—possibly a controlling—influence on the political and financial affairs of the nation. And if the business man may be brought to see irrigation (including water developments of every kind) as the absolute necessity of his community and his business, upon which both must depend for their prosperity—which in most western localities it assuredly is—we need not worry so much about what is going to be done with our forests, our rivers, our flood waters and our other resources. It will not solve all our problems, to be sure, but it will help immensely.

A Note of Pathos

WE WERE reading, the other evening, that entertaining and informing essay on "The Senate of the United States" by the master of expository prose and old-school statesmanship, Henry Cabot Lodge. The upper house of our national Congress, points out the late Massachusetts senator, is not only "the greatest deliberative body in the world," but with one exception—the English House of Lords—is the oldest. Moreover, the senate is the most stable and enduring institution of our government. It never dissolves; it is continuous. New administrations come and go, the House of Representatives must be newly organized, but the Senate goes on. The Senate of today is the same body, in point of continuity of existence, that heard Webster thunder his reply to Hayne, and Thurston urge the liberation of Cuba. There is pathos, therefore, in the reflection that our national Senate, upon all too many occasions, has age without dignity, and power without respect.

Washington Sentiment Divided Over Report on Columbia River Basin Project

Comments of Editors Run Gamut From Zealous Advocacy to Intolerant Condemnation of Plan

By THE DITCH-RIDER

WASHINGTON newspapers are apparently loath to set up their editorial judgments against those of the reclamation experts who have declared against the development of the Columbia River basin project by the federal government. In the comment elicited during September by the report of the special investigating commission, submitted to Secretary Work, declaring that the project is physically feasible, but that the time has not yet arrived for its development, several journals of the state voice their belief that the project should be carried forward in spite of the report; but most of them either are noncommittal or frankly approve of the Commission's findings.

Several editors state with apparent regret that the adverse recommendations are "disappointing"; others note prominently in their news columns that the Columbia Basin Irrigation League will bring the project before Congress in an attempt to secure action independently of the Interior Department heads; while others point out that the disapproval of the Commissioner of Reclamation and the Secretary of the Interior is not necessarily fatal to the plan. Several other papers find in the report of the investigators an official justification for their own failure to champion the plan, or their opposition to some of its features.

ONE of the newspapers which call vigorously for the construction of the project in spite of the unfavorable report is the Walla Walla *Bulletin*, which asserts:

"The report . . . is undoubtedly a setback for the big reclamation scheme, but it is by no means the last word thereon. It simply represents the present ideas of two department chiefs. . . . They found the project feasible, which is a big victory for the men who have long labored in its behalf, but they stated the time is not yet ripe for the federal government to take hold of it . . . No one has ever disputed the fact that the project would cost a large sum of money and that its settlement would be a difficult problem. . . . The fundamental question at issue, however, is whether the present rate of agriculture production warrants addition of such a large body of land to the farming area of the country. . . . The weight of expert opinion seems to be that the population of this country and of the world is increasing rapidly enough to justify steady advances in production. . . . The people of this state and of the Northwest would not want the Columbia Basin project built if it was not feasible, but since its latest and highest critics have pronounced it feasible, they believe it ought to be constructed. . . . Congress should disregard the 'watchful waiting' report of Messrs. Mead and Edwards, therefore, and make a start on the Basin project. . . The Columbia Basin League and the people of the great Inland Empire should keep right on fighting to secure the building of the project. They will win in the long run."

ANOTHER Walla Walla paper—the *Union*—agrees with its contemporary, and quotes with approval the statement of Roy R. Gill, chairman of the Board of Trustees of the Columbia Basin League, that "we have known all along that we would have to look to Congress and not to the Secretary of the Interior's office to build the project." The *Union* believes: "There is no need to become agitated over this matter. . . . Backers of the plan . . . are slowly gaining ground. . . The fight will go on and eventually will be won. We should feel encouraged, not discouraged, by the report."

The newspapers of Everett, Washington, are luke-warm in their reception of the investigators' report. The Everett *News* says: "The report will be disappointing to those interests in eastern Washington who have visualized for years the great expanse of arid land turned into rich orchards and prolific agricultural tracts producing enough to feed half the cities in the United States with an overflow for export." Then, pointing out some of the features which made the government chiefs naturally hesitant to commit the Reclamation Bureau to its construction, the *News* looks forward to the future realization of the Basin project by saying:

"However, the state has the land, which no one can carry off, and it has the rivers and lakes, which also will be there 25 or 50 years hence. So that while the development has run into a snag it is bound eventually to come with the steadily increasing population of the nation and the added need for producing acreage."

The Everett *Herald* is frankly scornful of statements which it quotes from several United States senators favoring the Basin project, one of which is credited to Senator Cameron, of Arizona, as follows: "It doesn't make any difference what Work and Mead think. The United States has money to develop such projects as the Columbia basin. Therefore why not do it now? Take the bull by the horns. Go out and get the money and put it over right now."

The *Herald* ironically says: "That's the stuff. Expand because we have the expanding habit. Spend the money because we have it to spend. Let's go, put it over, and all that sort of thing. It really doesn't matter that many irrigation projects the government has taken up are in arrears and that irrigated lands right now available are not properly utilized and that, under the circumstances, men who have examined the Columbia project believe it presents too many complications to be undertaken at this time. Expert knowledge doesn't mean much to some of our statesmen.

"All of us are not enamoured of many of these federal bureaus. Frequently their experts presume too much. They calmly assume legislative functions and we can't blame senators and even the common people if they protest occasionally. A bureau decision or an expert's opinion is not an unalterable fiat and yet such decision cannot with any degree of good judgment be altered by such logic as propounded by these senators from the Great West."

THE Yakima *Republic* wants the reclamation activities of the federal government to be concentrated in the Yakima Valley, and it condemns the Basin project without reservation and in somewhat intemperate language: "Frequent gatherings of citizens who from time to time indorse the proposal (the Basin project) . . . do not, as a rule, know what they are doing

(Continued on Page 35)

THE IRRIGATION DIGEST

A Monthly Bulletin Board of Brief Facts and Events from Far and Near

CALEXICO, CALIF.—One hundred thousand acres of productive land in the Colorado River delta, in Mexico, are to be brought under irrigation by pumping, if plans now undertaken by J. C. Allison are worked out successfully. Mr. Allison now has six wells pumping, and others drilling.

EL PASO, TEX.—Construction work on the Bluewater, N. M., irrigation project is scheduled to be started by October 1st, according to a statement by Vernon L. Sullivan, consulting engineer. Ten thousand acres will be brought under irrigation by the project at a cost of $350,000.

PHOENIX, ARIZ.—The Mohawk Valley Irrigation District has been authorized by the Arizona state certification board to proceed with an election for a bond issue of $500,000 to improve the district. The developments contemplated will involve the drilling of wells to water 20,000 acres.

LONG BEACH, CALIF.—Clark Shaw, city water superintendent, favors the acquisition of more water bearing lands by the city, and advocates in his annual report that such lands be secured close to Long Beach. He also urges the construction of two more reservoirs for the city with a total capacity of 1,500,000 gallons.

SAN FRANCISCO, CALIF.—The California Development Association contributed much to the investigation of conservation problems of the state, including flood control, municipal water supply, and irrigation water, in a week's conference, September 21-26, devoted to these and related subjects connected with the public lands.

ELLENSBURG, WASH.—A board of three members has been named to appraise the land and improvements of the Kittitas highline canal. It includes H. H. Johnson of the soil and economics department of the Reclamation Bureau; Phil S. Olmstead, pioneer Kittitas Valley farmer, and A. J. Turner, engineer of the Columbia Basin project.

FLORENCE, ARIZ.—Headquarters for the San Carlos reclamation project have been moved from San Carlos to Florence. The office which has been maintained at the Sacaton Indian Agency has also been transferred to this city. Diversion dams across the Gila River above Florence and Sacaton have been completed, and a large amount of canal work is now in progress.

WASHINGTON, D. C.—In an opinion rendered at the request of Hubert Work, Secretary of the Interior, Attorney General Sargent has held that the Secretary is not obliged to proceed with the development of the Baker project, which he does not consider economically feasible. Congress having appropriated funds for the project, critics of Work had held that he was obliged to proceed regardless of his own opinion.

IMPERIAL, CALIF.—New offices and shops for the Imperial Irrigation District, which have been under construction here during the past few months, are almost in readiness for occupancy, and the headquarters of the district are expected to be moved from Calexico to the new location before the end of the month. About fifty employees of the district will be transferred from Calexico to Imperial.

GRASS VALLEY, CALIF. — Water rights and other property of the Excelsior Water and Power Company, which have been in dispute between the company and the Nevada Irrigation District, have been purchased by the district, it has been announced from Washington by A. L. Wisker, general manager. The purchase clears the way for the immediate launching of the Nevada Irrigation District's $6,000,000 water and power project, which will affect 140,000 acres of land.

BOISE, IDAHO.—The reclamation district bond commission has authorized the certification of bonds of three eastern Idaho irrigation districts in the total amount of $200,000. The Idaho Irrigation District was certified in the amount of $126,000. The Progressive district's amount was $70,000, and the Popular district asked for only $4,000. All of the funds are to be used for the purchase of water from the American Falls reservoir, it was announced.

SAN FRANCISCO, CALIF.—The California Railroad Commission has granted permission to the Pacific Gas & Electric Company to issue $1,100,000 in bonds for the purpose of starting work on the construction of a $2,530,000 hydraulic plant on the Stanislaus River. The plant will use water from the Melones Dam, now in course of construction by the Southern San Joaquin and the Oakdale Irrigation Districts. The power company will pay the districts a total of $5,175,000.

OLYMPIA, WASH.—Applications have been filed with the state supervisor of hydraulics for the appropriation of water rights on the Quilcene and Little Quilcene Rivers for irrigation developments to cost eight million dollars. Cost of developments on the Quilcene River, entailing construction of twenty-five miles of pipe line, is estimated at $5,000,000, and the Little Quilcene River project, involving the building of a 20-mile pipe line, at $3,000,000. Commissioners of Jefferson County are the applicants.

EL CENTRO, CALIF.—Directors of the Imperial Irrigation District have been attacked from a new source by a demand filed by J. T. Collins, of Calipatria, for the repayment to the district of $53,000 alleged to have been "misappropriated" during the past several years. The funds in question are substantially the same which are involved in the action now pending in the Superior Court of Imperial County, in which Directors Rose, Aten, Brockman and Pound are accused of malfeasance in office. The accusations mainly grow out of expenditures authorized by the district in the interest of the Swing-Johnson bill.

Take Steps to Advance Utah and Oregon Projects

Secretary Approves Contract Forms for Salt Lake Basin and Vale Developments

Distinct progress was made during September in the arrangements for carrying out the Salt Lake Basin project in Utah, the Vale project in Oregon, and the Owyhee project in Oregon and Idaho as a result of the action of Secretary Hubert Work in approving proposals submitted to those interested in these projects.

In the case of the Salt Lake Basin project, a form of contract for the purchase of water from the Echo Reservoir, at a cost of $3,000,000, was approved and will be submitted to the water users who are forming an association to guarantee the repayment of this sum. Under the approved contract the United States is to build a reservoir of 74,000 acre feet capacity, and construct the Weber-Provo diversion canal with a capacity of 300 second feet of water. This contract will be placed before the organization that is forming the association in order that its conditions may be fully understood. It requires that the entire construction cost shall be repaid to the United States within twenty years, and that the United States shall be reimbursed for operation and maintenance expenses during the time the works are operated by the government. The operation and maintenance assessments are to be paid annually in advance. The amount appropriated by Congress for this project during the present fiscal year is $900,000.

The act providing for the construction of the Vale, Oregon, project, as passed by Congress at its last session, contains a provision authorizing the purchase of an interest in the Warm Springs reservoir, and for this purpose appropriated $200,000. A part of this purchase may have to be used to construct a drainage system for the Warm Springs Irrigation District, and if this expenditure is more than $200,000 the district must pay the government the difference. Secretary Work has approved a form of contract for the purchase of an interest in the Warm Springs Reservoir, and this has been forwarded to the local officials of the Bureau of Reclamation, for discussion with representatives of the Warm Springs Irrigation District. Because of legal complications involving the right of the district to convey an adequate interest in the storage reservoir, it is provided in the contract that the Secretary of the Interior may require the district to institute and prosecute a suit to determine the extent of the right to be conveyed to the United States.

Before construction can begin, another contract with the Vale Irrigation District will be necessary, and action by the State of Oregon, showing willingness to comply with a provision of the appropriation requiring the State of Oregon to assume certain duties and responsibilities, in the settlement of land and improvement of farms.

Secretary Work has also approved a draft of a letter to the Gem Irrigation District, and other districts to which water may be furnished from the reservoir and canals of the proposed Owyhee project. This letter proposes alternate plans for the payment of water charges and construction costs, if these districts are provided with water under Warren Act contracts by the Owyhee project.

New Deal Proposed for Strawberry Project

Contract Governing Payment of Debt and Transferring Control Submitted to Association.

A draft of a new contract proposed to be entered into between the United States and the Strawberry Water Users' Association by which the Association will take over the operation and maintenance of the Strawberry project in Utah has been approved by Secretary Work and submitted to the Association.

According to the terms of the proposed contract, the construction charge deficit now existing on this project is to be paid by the Association in 20 equal annual installments and in addition, the Association, by levying assessments on its members, is to collect and pay the government the amount of any deficit in any year when water users fail to pay their construction costs.

Lands Reclassified

Areas of public lands amounting to 6,666 acres in Alaska, Arizona, California, and Oregon were reserved by application under the Federal Water Power Act during the month of August.

More than 70,000 acres of land in Idaho, Montana, and Utah were included in formal orders designating the land as non-irrigable under the enlarged-homestead acts and to that extent subject to entry as homesteads of 320 acres or less. More than 60,000 acres in Idaho, Montana, New Mexico, and North Dakota were classified under the stock-raising homestead law and designated for entry in tracts of 640 acres or less. Much of the acreage involved in these designations is included in original entries or in applications under the enlarged and stock-raising homestead acts which confer a preference right.

Oregon Irrigation Securities Board Refuses Extensions

Denies Applications for Interest Guarantee of Three Districts; Grants Tumalo Extension

The Oregon Irrigation Securities Commission, meeting at Salem, Oregon, in September, received applications from four irrigation districts for an extension of the state's guarantee of the interest on their outstanding bonds, and refused to grant the desired extension on three of the applications.

The Silver Lake Irrigation District applied for an extension of the state guarantee on the interest on $275,000 in bonds for a period of one year. The application was rejected on motion of Governor Pierce, who declared that at a previous meeting of the commission the directors of the district had promised that they would not turn to the state for further financial assistance.

The Eagle Point District applied for an extension of the interest guarantee on bonds totalling $400,000 for a period of one and one-half years. In refusing to grant the extension the board declared that it would be willing to consider arguments in its favor which might be advanced by the directors of the district.

The Lone Pine Irrigation District requested two years extension on the interest on $95,000 worth of bonds and two and one-half years extension on $94,000 worth. Both applications were refused.

The applicaion of the Tumalo Irrigation District for extension of the guarantee for one and one-half years on $650,000 worth of bonds was acted upon favorably, the commission explaining that this district differed from the others in that the state was in a measure responsible for its settlement.

Buy Machinery for Imperial

W. O. Blair, director, and A. L. Graves, master mechanic of the Imperial Irrigation District, have returned from the east after making extensive purchases of shop equipment authorized by the district. By careful buying, according to their announcement, savings amounting to $13,000 were effected in acquiring the machines. The equipment purchased includes: One milling machine, $1,750; one 14x96 plain grinder, $2,000; one 18-inch key seating machine, $575; one tool grinder for cutter work, $400; one Heald cylinder grinder, $750; one 48-inch lathe, $2,800. The machines are said to be in perfect condition.

New Mexico Irrigation Law Ruled Void

Attorney-General Holds Act Conflicts With Provisions of State Constitution

James N. Bujac, Assistant Attorney-General of New Mexico, has ruled unconstitutional Chapter 107, Laws of 1923, of that state, which is "An act relating to lands within and forming part of certain irrigation districts which have heretofore or may be hereafter sold for delinquent taxes." The grounds on which the law is declared in conflict with the state constitution, as set forth in his statement, are that it attempts to extend the time of payment of taxes, and to take the property taxes out of the hands of the state treasurer for three years, thus seeking to regulate the acts of that official.

In his opinion Mr. Bujac sites Sec. 24, Art. IV, of the state constitution which provides: "The legislature shall not pass local or special laws in any of the following cases: Regulating . . . . the assessment or collection of taxes or extending the time of collection thereof . . ." and adds:

"Has this section of the constitution been violated in the present case? The county treasurer generally when land is sold to the county for taxes, holds such land until such time as he can sell it to some third person for the amount due for taxes, interest, penalties and costs or until the original owner of the land redeems the property by paying the taxes, interest, penalties and costs due. Sec. 2 of said Chapter 107 makes it obligatory on the part of the county treasurer to, "at any time after the expiration of the period or redemption provided by law" and provided the property has not been redeemed or sold by the county, "deliver a tax deed conveying said land to the board of directors of the irrigation district in which the land is located, subject to a prior lien for taxes, interest, penalties and costs. Sec. 3 then makes it obligatory on the part of said board of directors to sell said land for not less than the amount of the lien and to pay the county treasurer the amount of said lien with a provision in Sec. 5 that if the amount of the lien be not fully paid within a period of three years from the date of such deed, the county shall at the expiration of said three-year period become reinvested with the title conveyed so that Chap. 107 not only extends the time for the collection of taxes but absolutely takes the land out of control of the county treasurer for this three year period and thus attempts to regulate the acts of the county treasurer by special legislation which in view of the decision of our supreme court, heretofore quoted, the legislature is prohibited from doing by Sec. 24, Art. 4 of our state constitution.

"Then again this chapter does not provide that the board of directors shall pay to the county until they have sold the land in question and this in reality means that there is an actual transfer of an obligation due to the county without any consideration, or, at best, it postpones the liability which is in violation to Sec. 32, Art. 4 of the constitution of this state which reads:

" 'No obligation or liability of any person, association or corporation, held or owned by or owing to the state, or any municipal corporation therein, shall ever be exchanged, transferred, remitted, released, postponed, or in any way diminished by the legislature, nor shall any such obligation or liability be extinguished except by the payment thereof into the proper treasury or by proper proceeding in court.' "

Warns of Forest Problem

George H. Barnes, president of the American Reforestation Association, speaking recently before a Southern California service club, brought before his audience some compelling facts relative to the dependence of water supply on forest cover. Depletion of timber has reduced the underground water supply of the nation to 47 per cent and that of Southern California to 17 per cent, he declared. He pointed out that forested mountain areas preserve 92 per cent of the rainfall, while only 20 per cent of the precipitation is saved in denuded sections.

Mr. Barnes pictured the situation as a national peril threatening every state in the nation. "Every state has water trouble," Barnes said. "It is the direct result of forest destruction. Depletion of forests without reforestation is the most awful indictment of a people in the history of the world."

New Arizona Company

To simplify methods of operation and clarify the irrigation situation on the Pima Farms Company's project, southern Arizona, a new company, the Catalina Water Company, will be formed to conduct the irrigation of a large tract under separate control. Articles of incorporation have been filed with the Arizona Corporation Commission. The capital stock of the company is $1,000,000, and George R. Darnell and A. R. Conner are the incorporators.

Wind Conditions Complicate Irrigation Problems

Fall Winds Make Special Care Necessary in Giving Trees Proper Moisture Supply.

Wind conditions in parts of the Southwest make the problem of orchard irrigation an especially complicated one during the fall season, says Harold Wahlberg, a Southern California horticultural expert, in a recent statement. Special care must be observed to see that the tree is adequately supplied with water to meet the large demands of the windy days when humidity is below normal, and yet the root system must not be weakened with excess moisture, he points out. Mr. Wahlberg says:

"With the approach of the fall season orchardists are confronted with the possibilities of the annual desert winds. Past experience and observations have conclusively shown that there is a direct relation between wind injury resulting from exposure to desert winds and the condition of the soil moisture in the orchard at the time and during the period previous to the windy season. It is well, particularly at this time, to see that the trees are supplied with an ample amount of soil moisture in order that the supply may be sufficient to take care of the extra demands made upon the tree during the periods of low humidity.

"Wind injury is not only influenced by the proper moisture conditions at this season of the year and during the immediate period of wind exposure, but it has been found that the general moisture condition throughout the year must be kept at an optimum growing point, if we would get the best results. In other words, the tree's ability to resist unfavorable wind action is largely dependent on the condition of the root system at the time of the hot blasts. If the roots have enjoyed optimum growing moisture throughout the growing season, the tree will be able to take up ample supplies of moisture during the emergency period because of the maximum absorption facilities of its normal root system.

"On the other hand, if the roots have been subjected to excessive wet conditions, they have been automatically weakened and will not be able to function to a normal degree when an extreme weather emergency arises, but in the case of normal roots, the danger of irrigation at this time of the year is improbable.

"As we enter on the fall period, we should continue the use of the soil augur to determine how deep we ought to apply moisture at this time of the year."

IRRIGATION MANAGEMENT

THE IRRIGATION MANAGER A BUILDER FOR THE AGES

By H. M. CHADWICK

Assistant State Engineer of Oregon

This article is taken from an address delivered by Mr. Chadwick before the Oregon Irrigation Congress, in session at Grant's Pass, Oregon, early in October. Mr. Chadwick's topic was "Water Use," and was, of course, covered much more comprehensively than has been possible in the limited space here available.

WE who live in this glorious western country, rarely, if ever, realize the many obstacles which were thrown in the way of its development. After the war with Old Mexico and when the treaty of Guadalupe Hidalgo was signed, we acquired by right of conquest a vast area of land, including some of the richest territory now in the West.

We are now inclined to look upon our fertile fields and vast irrigated valleys and thriving, busy cities with an air of complacency, taking these things as a matter of course; but let us for the moment digress and turn our heads toward the past and view for a moment the attitude once taken by a vast number of eastern people toward this matter of development of the West.

MOST notable among the outbursts of censure against the acquirement of more land was a memorable speech by no less a personage than the brilliant senator, Daniel Webster—Webster, a man of wonderful intellect, an orator able by the eloquence of language to sway public sentiment and to attain in a large degree the objects he fought for. Mr. Webster took his stand against the acquisition of more territory, and in part said:

"What do you want of that vast and worthless area, that region of savages and wild beasts, of deserts, of shifting sands and whirling winds, of dust, of cactus and prairie dogs? To what use could we ever hope to put those great deserts, and those endless mountain ranges, impenetrable and covered to their very base with eternal snow? What can we ever do with the western coast, a coast of three thousand miles, rockbound, cheerless and uninviting?"

IT IS occasionally a salutary thing for the executive to look at his job in the abstract—in its relation to the past and the future rather than the petty worries of the day. That is what Mr. Chadwick has done in this extract. He has given us a glimpse backward and a vision forward. He concluded his speech before the Oregon Irrigation Congress by quoting the following from an anonymous source:

"'Although the tomb of Moses is unknown, the traveler of today slakes his thirst at the well of Jacob. The gorgeous palaces of the wisest and wealthiest of monarchs, with their cedar and gold and ivory, and even the great temple of Jerusalem, hallowed by the visible glory of the Deity Himself, are gone; but Solomon's reservoirs are as perfect as ever. Of the magnificent and costly architecture of the Holy City, not one stone is left upon another, but the pool of Bethesda commands the pilgrim's reverence at the present day. The columns of Persepolis are moldering into dust, but its cistern and aqueduct remain to challenge our admiration. The golden house of Nero is a mass of ruins, but the Aqua Claudia still pours into the city of Rome its limpid stream. The Temple of the Sun, at Tadmor in the wilderness, has fallen, but its fountain sparkles in the rays of the morning as when thousands of worshipers thronged its lofty colonnades. And if any work of this generation shall rise over the deep ocean of time, we may well believe that it will be neither a palace nor a temple, but some vast aqueduct or reservoir.'"

It is fortunate that Mr. Webster did not prevail, for some other nation might now be developing the West of today. Look at what has been done with that 3,000 miles of rockbound, cheerless coast, that Mr. Webster scorned. Picture the thriving, hustling cities—the wonderful garden spot of the Imperial Valley, once a vast and worthless area, and realize that the use of water was the prime factor in the development of this great area.

The use of water has brought the "howling wilderness" to a state of beauty and productivity. The use of water is indeed the burning question. It is the life blood of the West. Without it we parch and burn; with it we revel in a glorious profusion of growth. We know the value of water. We see it demonstrated in various ways, and in many different parts of the country. It remains only for us to learn a more efficient use of this water. It remains for us more fully to realize the actual wealth that lies within it.

MODERN irrigation practice is still undergoing changes. Many studies have been made by competent investigators on the duty of water and the manner of the preparation of the land to receive the water.

The United States Department of Agriculture through its department of irrigation investigations and under the guiding hand of that grand old man of irrigation, Dr. Fortier, has done wonderful work in determining, through actual experiment, the duty of water for various crops in many different types of soil, and in many different localities.

Our own Oregon Agricultural College, through Professor W. L. Powers, Chief in Soils, has conducted duty of water experiments of inestimable value throughout the State. Oregon Agricultural College Bulletin Number 140 entitled, "The Economical Use of Irrigation Water," by Professor Powers contains a veritable fund of detail showing the results of his experi-

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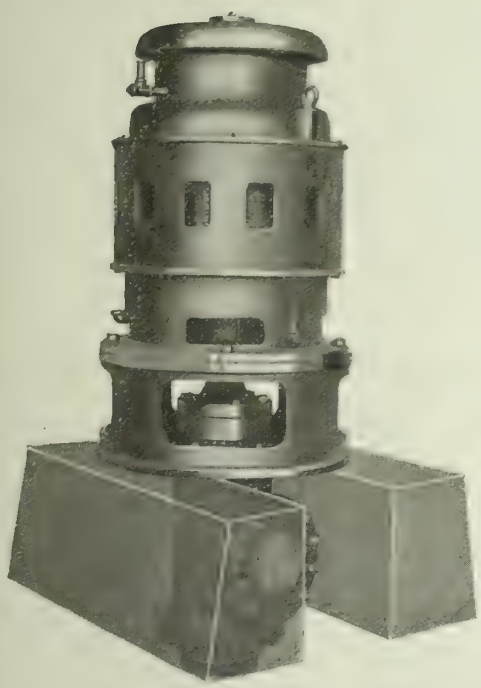

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City of Beverly Hills, Beverly Hills.....Two
City of Compton, Compton.....Two
City of El Monte, El Monte.....One
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City of Monrovia, Monrovia .....One
City of Santa Monica, Santa Monica.....Three
Claremont Domestic Water Company, Claremont One
Compton Union High School, Compton.....One
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Fillmore Orchard Company, Fillmore.....Two
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Jones, G. Merrit, Porterville .....One
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Linda Vista Water Company, Colton.....One
Lomita Water Company, Lomita.....One
Michigan Land & Water Company, E. Pasadena One
Montebello Land & Water Company, Montebello One
Moorpark Farmers Water Company, Moorpark..Two
Newhall Land & Farming Company, Saugus.....One
Oildale Mutual Water Company, Bakersfield.....One
Omaha Water Company, Covina.....One
Pellissier, F. F., Whittier.....Two
Perkins Rock & Gravel Company, San Fernando One
Platt, George E., Los Angeles Creamery Co.....Four
Rio Hondo Country Club, Downey.....One
San Juan Point Corp., Laguna Beach.....One
San Pedro Golf Club, San Pedro.....Two
South Mesa Water Company, Redlands.....One
Southern California Edison Company.....Four
Valley Water Company, Pasadena.....One
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The waste of water under any circumstances is deplorable. It may not be clear to some water users what, if any, benefits they would receive by saving for others a part of the water supply they are authorized to use. In meeting this objection one has to remind the water user that maximum yields can be obtained with ordinary quantities of water properly applied, and that when an excess quantity is applied it tends to leach out plant food, water-log the soil or bring up alkali.

THE expression is sometimes used, "Where water is cheap and land is valuable, etc." Those days are gone forever. Water may be cheaply applied, that is to say, a system confronted with little or no difficulties may be constructed cheaply and the cost to the farmer may be very reasonable, but by reason of the great areas of arid, arable lands and the deficiency of natural water, because of this aridity, water, or the right to use it, is never cheap.

The use of water is indeed a science and as time goes on and available sources are appropriated and used the State's job of administering the waters will become increasingly complex and difficult and will require the assistance of all intelligent water users who realize that the only path to successful irrigated farming is through the economical use of water.

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(*Continued from Page 17*)

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Keeping the soil then supplied with moisture up to its field capacity is bad practice and has been found to cause dying of roots and an unhealthy and unprofitable orchard. The grower should be cautioned not to go to the other extreme and let his soil get too dry, but to maintain his moisture content as near the optimum as possible.

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Water passes down through light soils quickly with relatively little lateral movement. It percolates through heavy soils slowly with an increased lateral seepage. Light soils such as sandy and gravelly ones have comparatively large soil particles and consequently less pore space than heavy soils which have small soil particles. The lighter soils have a lesser number of soil particles and consequently are retentive of a lesser amount of water. They dry out sooner and need to be supplied with water more often than heavy ones.

Irrigation in furrows is the method most used in citrus orchards. When it is used in orchards of sandy or light soils, furrows approximately 250 to 300 feet should be the limit; otherwise to wet properly the portion of the orchard farthest away from the source of water, too deep penetration is realized in the part nearest the source. In heavy soils longer furrows can be used because of the slower penetration, although probably 500 feet should be about the limit. Soils with a plow sole do not irrigate well under the furrow system because there is not sufficient loose soil to absorb and hold enough water for penetration. Plow sole should be broken up.

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HYDRAULIC ENGINEERING

Dealing with the Practical Problems of the Operating and the Consulting Engineer

NEW VENTURI FLUME DECLARED DISTINCT ADVANCE

By RALPH L. PARSHALL

Senior Irrigation Engineer, Bureau of Public Roads, U. S. Department of Agriculture.

This article is reprinted, with permission, from the Proceedings of the American Society of Civil Engineers. Mr. Parshall's paper was recommended for publication by the Society's special committee on Irrigation Hydraulics. A few paragraphs of the paper are necessarily omitted.

MEASUREMENT of flowing water in irrigation practice often requires that little loss of head be sacrificed by the measuring device. Because of the relatively large loss of head, the standard overfall weir is, in many cases, objectionable. Although when operating under standard conditions, it is one of the most accurate of measuring devices for practical field installation, it is not always possible to maintain these standard conditions, such as proper bottom contraction, velocity of approach, and aeration of nappe. The submerged orifice has not met with entire success because of the uncertainty of the coefficient of discharge, velocity of approach, and constancy of condition. The ordinary rating flume often becomes inaccurate within a short time.

To meet the objections found in other measuring devices now in common use, the present Improved Venturi Flume has been developed. The improvements over the old Venturi flume consist in the reduction of the convergence in the inlet section, lengthening of the throat section, change of divergence of the outlet section, and depressing the floor in the throat section. These changes have improved the flow conditions, reduced the effect of submergence, and simplified the operation by reducing the number of gauges necessary to determine the discharge.

Type of Structure—This flume (Fig. 1) has three major parts, a converging inlet, a parallel-sided throat, and a diverging outlet. All the side walls are vertical. The inlet has a level floor between the sides, each side converging at a rate of 1 ft. in 5 ft. of length. The floor of the throat slopes downward with a vertical fall of 9 in. in a horizontal distance of 2 ft. The outlet floor slopes upward at the rate of 6 in. in 3 ft., and each wall diverges at the rate of 1 ft. in 6 ft. of length. The crest is the down-stream end of the level floor, and the crest length or size of flume is the distance, in feet, between the vertical walls of the throat. The lengths of the throat and the outlet of the flume are 2 and 3 feet., respectively, for all sized flumes from 1 ft. to 8 ft. The side of the inlet is made longer as the width of the flume increases, according to the arbitrary rule, $\frac{W}{2} \div 4$, in which W is the width of the flume, or crest length, in feet.

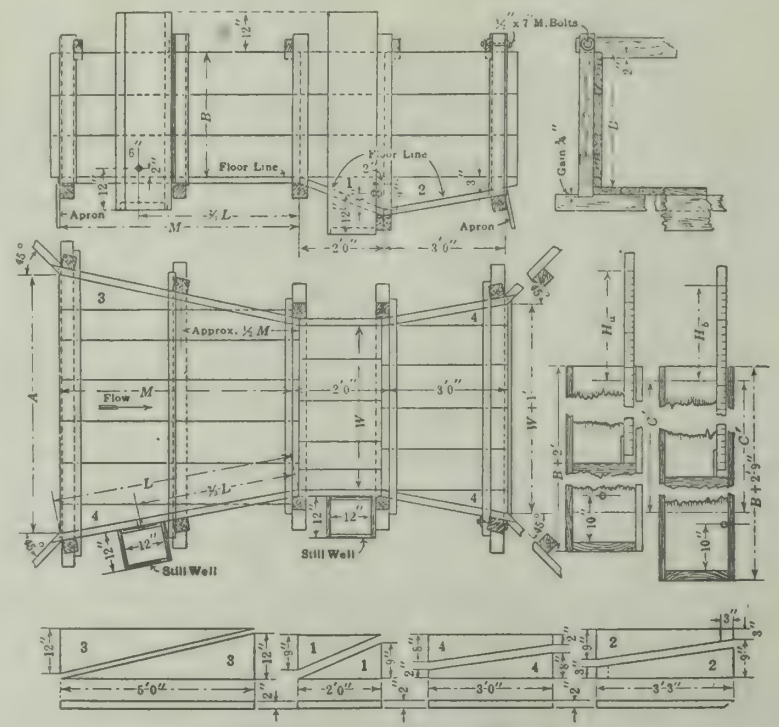
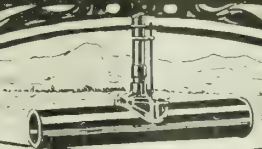


FIG. 1.—IMPROVED VENTURI FLUME.

THERE are two general conditions of flow, namely, "free flow" when the elevation of the water surface at the throat gauge, or *Hb*, is lower than the crest, and "submerged flow", when the elevation of the water at the throat gauge is higher than the crest. The upper head, *Ha*, is observed at a point two-thirds the distance from the crest to the upped end of the inlet, along the side-wall, whereas, the throat head, is observed at a point 3 in. vertically and 2 in. horizontally up stream from the lowest point of the depressed throat floor. Both the upper head, *H-a*, and the throat head, *H-b*, are referred to the crest level as the datum. Under certain conditions of flow the throat reading may be negative.

Laboratory Tests.—Calibrations were made on flumes having crest lengths of 1, 2, 3, 4, 6 and 8 ft. with a minimum flow of 0.3 sec.-ft. through the 1-ft. flume, and a maximum of 62.5 sec.-ft. through the 6-ft. flume, the supply not



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It is easily adaptable to any submerged orifice and can be slipped into its bracket supports or removed instantly.

Meters the **main flow** without diversion and is sufficiently protected from floating trash to insure reliable operation.

Registers directly either in acre-feet or in lineal feet of flow.

Is low in price and a thoroughly practical field meter.

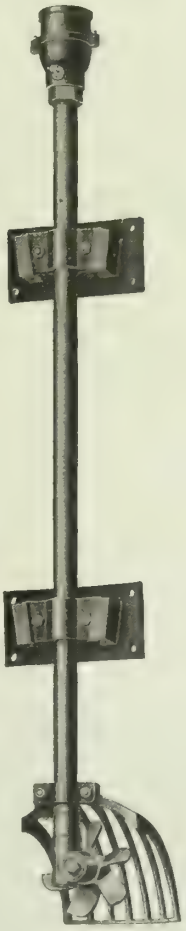

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TABLE 1. — Showing Number of Observations and Distribution of Errors, Free-Flow and Submerged Flow up to 71 Per Cent of Upper Head. Improved Venturi Flume.

Size of flume, in feet	Total observations	Percentage of observations under 5% error	PERCENTAGE OF ERROR — NUMBER OF OBSERVATIONS*										
			0-0.9	1.0-1.9	2.0-2.9	3.0-3.9	4.0-4.9	5.0-5.9	6.0-6.9	7.0-7.9	8.0-8.9	9.0-9.9	10.0-10.9	11.0-11.9
1	32	75	6	5	3	1	3	[illegible]	0	1	[illegible]	0	0	1
			9	1	0	0	0	0	0	0	0	0	0	0
2	31	81	6	5	2	4	1	0	0	1	....	....	....	....
			4	8	0	0	0	0	0	0	....	....	....	....
3	33	94	5	4	2	1	1	....	....	....	....	....	....	....
			12	[illegible]	[illegible]	0	[illegible]	....	....	....	....	....	....	....
4	19	95	3	4	0	0	....	....	....	....	....	....	....	....
			6	4	1	1	....	....	....	....	....	....	....	....
6	14	100	2	1	0	....	....	....	....	....	....	....	....	....
			1	6	4	....	....	....	....	....	....	....	....	....
8	23	96	5	1	1	0	0	0	0	0	1	....	....	....
			12	[illegible]	0	0	[illegible]	0	0	[illegible]	[illegible]	....	....	....

*The table is presented to show the number of tests, within the limits indicated, in which the computed values are, respectively, greater or less than the observed values. Figures set in ordinary, or light faced type, are to be read as positive figures, and indicate the number of times the computed values are greater than observed values. Figures set in black-faced type are to be read negative, and indicate the number of times the computed figures values are less than the observed values.

mum through the 8-ft. flume. The discharge in second-feet through this device, under free-flow conditions and under submerged conditions when the down-stream head does not exceed 70 per cent of the upper head, is very closely approximated by the empirical formula:

$$Q = 4\ W\ Ha^{1.522\ W^{0.026}}$$

in which,

Q = discharge, in second-feet.

W = width of flume or crest length, in feet; and

Ha = upper head, in feet.

THE accuracy of this device under these conditions is believed to be sufficient for practical field purposes. Table 1 shows the distribution of errors resulting from the comparison of the observed discharges with the results computed from the empirical formula. In determining the errors and their signs, the observed values are taken as the basis of comparison. Table 1 is based on the complete free-flow series of tests made on the six sizes of flumes studied, except one test which is believed to be in error * and the submerged flow tests for submergence up to 71 per cent of the upper head. Submergence, as herein mentioned, means that the water surface, as indicated by the throat gauge, or Hb, is positive or above the crest level. For conditions of flow, as shown in Figs. 3 and 4, the degree of submergence, as indicated by the ratio, $Hb:Ha$, is somewhat less than the actual submergence would be if the water surface in the outlet were considered.

*Test No. 6512 on the 3-ft. flume, in which $Ha = 0.705$ ft.; $Hb = 0.264$ ft.; percentage of submergence = 0; observed quantity = 8.33 sec. ft.; computed quantity = 6.94 sec.-ft.; percentage of error = 16.7.

Table 2 shows the percentage of deviation of the calculated free-flow from the observed discharge, where the degree of submergence varies from 69 to 79 per cent. It will be noted in this table that the agreement of calculated and observed values increases with the head, as well as with the width of flume. The increased velocity of the water in the throat section, together with the action of the depressed floor, causes a hydraulic jump to be formed immediately below in the diverging outlet of the flume. This combination of increased velocity and depressed floor has the effect of resisting the submergence up to a point of about seven-tenths of the upper head, Ha. It will be observed in Table 2 that for the 1-ft. flume and small flow the velocity is not sufficient to overcome the resistance of the water held in the depressed sec-

TABLE 2. — Comparison of Calculated Free-Flow with Observed Discharge for Submergence Varying from 69 to 79 Per Cent.

Test No.	Ha, in feet	Hb, in feet	Percentage of submergence	Observed discharge, in second-feet	Calculated discharge, in second-feet	Difference	Percentage of deviation
			1-Foot Flume				
6707	0.200	0.141	70.5	0.31	0.35	0.04	12.9
6703	0.398	0.276	69.3	0.91	0.98	0.07	7.7
6667	0.600	0.424	70.7	1.74	1.84	0.10	5.7
6699	0.599	0.448	74.8	1.71	1.84	0.13	7.6
6695	0.801	0.568	70.9	2.72	2.85	0.13	4.8
6694	0.802	0.605	75.4	2.69	2.86	0.17	6.3
6710	1.002	0.708	70.7	3.86	4.01	0.15	3.9
6689	1.001	0.759	75.8	3.78	4.01	0.23	6.1
6686	1.202	0.857	71.3	5.10	5.29	0.19	3.7
6675	1.603	1.200	74.9	7.73	8.20	0.47	6.1
			2-Foot Flume				
6645	0.201	0.140	69.7	0.62	0.66	0.04	6.5
6646	0.201	0.154	76.6	0.61	0.66	0.05	8.2
6637	0.402	0.281	69.9	1.87	1.95	0.08	4.3
6638	0.402	0.298	74.1	1.82	1.95	0.13	7.1
6631	0.598	0.421	70.4	3.49	3.60	0.11	3.2
6632	0.602	0.456	75.7	3.38	3.64	0.26	7.7
6606	1.002	0.707	70.6	7.89	8.02	0.13	1.7
6607	1.000	0.768	76.8	7.70	8.00	0.30	3.9
6612	1.602	1.127	70.3	16.51	16.61	0.10	0.6
6613	1.593	1.217	76.4	15.89	16.47	0.58	3.7
			3-Foot Flume				
6579	0.199	0.140	70.4	0.92	0.96	0.04	4.3
6575	0.298	0.221	74.2	1.71	1.80	0.09	5.3
6528	0.399	0.298	74.7	2.75	2.85	0.10	3.6
6520	0.503	0.379	75.4	3.93	4.09	0.16	4.1
6534	0.595	0.446	75.0	5.13	5.32	0.19	3.7
6556	0.600	0.466	77.7	5.13	5.39	0.26	5.1
6514	0.699	0.499	71.4	6.74	6.85	0.11	1.6
6553	0.900	0.647	71.9	10.09	10.17	0.08	0.8
6543	0.996	0.710	71.3	11.84	11.93	0.09	0.8
6561	0.999	0.769	77.0	11.92	11.98	0.06	0.5
6563	1.000	0.754	75.4	11.81	12.00	0.19	1.6
6544	1.004	0.799	79.6	11.79	12.08	0.29	2.5
6572	1.200	0.836	69.7	15.99	15.96	—0.03	0.2
6411	2.039	1.509	74.0	35.23	36.62	1.39	3.9
6408	2.358	1.697	72.0	45.66	45.98	0.32	0.7
			4-Foot Flume				
6399	1.014	0.791	78.0	15.09	16.35	1.26	8.4
6395	1.339	0.977	73.0	24.55	25.36	0.81	3.3
6373	1.702	1.293	76.0	35.44	37.03	1.59	4.5
6382	2.008	1.475	73.5	46.31	48.07	1.76	3.8

tion, or, in other words, the point of measuring the throat head, *Hb,* is too far down stream to be within the range of the draw-down of the water surface for these small heads.

For the most satisfactory operation of this device, it is recommended that the flume operate under conditions in which the submergence does not exceed 70 per cent. Under such conditions only one observation of depth is necessary to determine the rate of flow. For submergence greater than 70 to 75 per cent, the discharge is then a function of both the upper head, *Ha,* and the throat head, *Hb.* Laboratory tests show that when the submergence is greater than about 98 per cent, no great dependence can be placed on the measurement.

Field Tests—Since completing the calibrations of the various sized flumes, outside field installations have been made to test the device under practical conditions. At Wellington, Colo., a small lateral was selected having a flat grade, where the stream of water carried some sand and silt. In this case there is an experimental 3-ft. Improved Venturi Flume in the lateral, where the upper head, *Ha,* is 0.86 ft., and the throat head, *Hb,* 0.63 foot, with a difference of 0.23 foot, the ratio, *Hb*:*Ha,* being 73 per cent. The discharge under this condition is in accordance with the free-flow law and the rate of flow can be assumed to be a function only of the upper head, *Ha,* thus giving a discharge of 9.48 sec.-ft. A standard weir will not operate successfully in this lateral, first, because of the deposit which would occur in the weir box; and, second, because of the small head available. This discharge of 9.48 sec.-ft. over a 3-ft. rectangular weir would require a head of exactly 1 foot, and to this possibly an extra 0.10 foot should be added to assure a complete aeration, making a total loss of head of about 1.1 ft. By careful measurements with an engineer's level, the loss of head through the Improved Venturi Flume, under the conditions as stated, was only 0.19 ft.†

Under conditions where sand and silt occur, it has been observed that if a difference in head of 0.05 to 0.10 ft. can be maintained for a moderate upper head, no deposit will accumulate in the flume even where excessive quantities of sediment are carried in the stream.

Velocity of approach seems to have little or no effect on the rate of discharge for free-flow conditions.

†Note approximately similar conditions of heads for the 3-ft. flume, Table 2.

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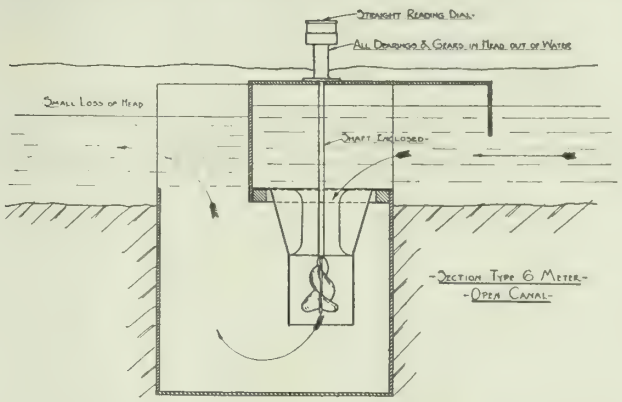
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WITH THE WATER COMPANIES

Of Interest Expressly to Water Works Engineers, Superintendents and General Managers

WATER WORKS MEN ARE MEETING IN CONVENTION

THREE hundred California water works men — responsible executives of city water departments and private water companies throughout the state — will gather October 15 for a three day session at Santa Cruz, California, in the sixth annual convention of the California Section of the American Water Works Association.

The Casa Del Rey, picturesque Santa Cruz hotel, will be the convention headquarters.

The eyes of the water works profession will be centered on California during the time that the convention is in progress, for the California Section of the national association has proved itself, during the six years since its organization, to be one of the livest and most progressive regional divisions in the entire country. During the past year the California Section was awarded the Nicholas C. Hill cup for the greatest growth of any of the Sections of the American Water Works Association.

The national body is comprised by the leading water works officials, executives and engineers throughout the United States, and the California Section's membership includes representatives of nearly every water works department and corporation in the state.

GEORGE W. PRACY, superintendent of the Spring Valley Water Company, San Francisco, and president of the California Section, will preside over the sessions of the convention. Fred M. Randlett, National Director of the American Water Works Association, and formerly chief engineer of the Department of Water of the city of Portland, Oregon, will represent the national association.

No effort has been spared by the executives of the Section to plan a convention that will be crowded with benefits to the attending delegates. Beginning with registration in the Sun Room of the Casino at the convention hotel, at 10:00 a. m., Thursday, October 15, a program full of interesting and practical papers, discussions and reports has been prepared, and the business sessions will be agreeably relieved by lighter things prepared for the enjoyment of those attending.

An informal dinner, with speeches that are guaranteed to be different from the usual run of post-prandial oratory, will close the first day's session. Chester Rowell, well-known California writer and lecturer, will be the principal speaker.

CALIFORNIA Section of the American Water Works Association is in convention at Santa Cruz as this magazine comes from the press, enjoying the benefits of a carefully prepared program, replete with helpful discussions and delightful entertainment. The complete program of the convention, at which three hundred delegates are expected, is given in this article. Next month MODERN IRRIGATION *will have a complete story of the convention. The California organization is one of the most progressive of the regional divisions of the national association, and is accomplishing much for its membership and the profession in general by its work on the Pacific Coast.*

A dinner-dance will be extended to the convention as a courtesy from the exhibitors of equipment, on Friday evening, and on Saturday, dull care will be pushed aside entirely and the convention will be conveyed en masse by the city and Chamber of Commerce of Santa Cruz on an automobile tour around historic and beautiful Monterey Bay and to the Big Trees and other points of interest.

THE COMMITTEES in charge of the convention include the reception committee, comprised by R. W. Keene, Hersey Manufacturing Company, Los Angeles; R. M. Northup, Neptune Meter Company, Los Angeles; and Judy I. Prugh, superintendent of Water, Sacramento, and the local committee on arrangements, comprised by George C. Pratchner, commissioner of public works, and R. S. Tait, water department superintendent, both of Santa Cruz.

Associate members of the association, who are for the most part manufacturers or dealers in equipment and supplies used by water works in construction and maintenance, will have an interesting and instructive display of their goods as one of the features of the convention. The committee on exhibits includes: R. W. Martindale, Pacific Coast Manager, U. S. Cast Iron Pipe & Foundry Company; C. B. Abbott, president, Water Works Supply Company, and J. R. Baker, Pacific Coast Manager, Neptune Meter Co., all of San Francisco; Frank M. Brooks, Manager Art Concrete Works, Pasadena, and J. J. Swenson, Pacific Coast Manager, American Cast Iron Pipe Company, Los Angeles.

New officers of the California Section are to be elected by the convention at the close of the business of the first day. The 1925 officers are: George W. Pracy, Superintendent Spring Valley Water Company, San Francisco, Chairman; C. B. Jackson, Superintendent Fresno City Water Corporation, Fresno, Vice-Chairman; P. Diederich, Superintendent, Department of Public Service, Glendale, Member Executive Committee; John Burt, General Manager, Marin Municipal Water District, San Rafael, Calif., Member Executive Committee; S. B. Morris, Superintendent and Chief Engineer, Pasadena Water Department, Pasadena, Calif., Secretary and Treasurer.

The convention program is announced as follows:

THURSDAY, OCTOBER 15TH

10: A. M.—Sun Room, The Casino, Hotel Casa Del Rey—General get together, registration and review of exhibits.

2:00 P. M.—Sun Room, The Casino, Hotel Casa Del Rey.

Address of Welcome

Hon. J. B. Maher, Mayor of Santa Cruz

Reading of Papers

1. "Recent Improvements in the Santa Cruz Water System," George C. Pratchner, Commissioner of Public Works, and E. C. Tait, Superintendent, Santa Cruz Water Department.

2. Symposium: "Service Installation Methods and Standards." Discussion to be opened by George Read, Superintendent, Meter and Service Department, Bureau of Water Works and Supply, Los Angeles.

3. Symposium: "Meter Maintenance Methods." Discussion to be opened by J. H. Fagg, Pacific Gas & Electric Corp., Stockton.

6:30 P. M.—Informal Dinner, Hotel Casa Del Rey.

Business Meeting—Reports of Retiring Officers. Reports of Committees. Election of New Officers, Selection of next place of meeting. Speakers, Hon. Judge Harry C. Lucas, Santa Cruz, and Hon. Chester H. Rowell, prominent lecturer and former member of California State Railroad Commission.

FRIDAY, OCTOBER 16TH

10:00 A. M.—Sun Room, The Casino, Hotel Casa Del Rey.

Reading of Papers

1. "Design and Construction of Concrete Lined Distribution Reservoirs," I. E. Flaa, Chief Draftsman, Spring Valley Water Company, San Francisco.

2. "Design of Balancing Reservoirs and Stand Pipes for Flat Cities and Communities." E. K. Barnum, Engineer, Fresno City Water Corporation.

3. Symposium: "Jointing Methods for Water Mains." To be led by Clark H. Shaw, Chief Engineer and Superintendent, Long Beach Water Department.

2:00 P. M.—Sun Room, The Casino, Hotel Casa Del Rey.

Reading of Papers

1. "Relation of Railroad Commission to the Water Works Man," W. R. MacKall, Hydraulic Engineer, California State Railroad Commission.

2. "Cooperation between the Water Works and Fire Departments in Decreasing Fire Losses," Thomas Baird, Chief Engineer Fire Department, Fresno.

3. "Use of Mechanical Equipment in Trenching, Backfilling, and Pipe Laying," Thomas Brooks, Assistant Superintendent, Bureau of Water Works and Supply, Los Angeles.

The following five minute papers and general discussion of water works problems to be presented as time permits after main papers at regular sessions:

1. "Methods used in moving 36-inch Riveted Steel Water Main," Judy I. Prugh, Superintendent, Distribution, Sacramento Water Department.

2. "Relation of Water Pressures, Service Sizes and Interior Fixtures to Complaints of Inadequate Water Service," V. E. Perry, Assistant Manager of Water Sales, Spring Valley Water Company, San Francisco.

3. "Methods of Protecting Services and Meters during Street Grading and Paving Operations." P. Diederich, Superintendent Public Service, Glendale.

6:30 P. M.—Hotel Casa Del Rey—Dinner-dance as guests of the exhibitors.

SATURDAY, OCTOBER 17TH

10:00 A. M.—Leaving Hotel Casa Del Rey promptly at 10:00 a. m. Automobile trip with basket lunch to Big Trees and other points of interest around the famous Monterey Bay, as guests of the City and Chamber of Commerce of Santa Cruz. Returning to Hotel by 4:00 P. M.

Washington Opinion Divided on Basin Project

(*Continued from Page 22*)

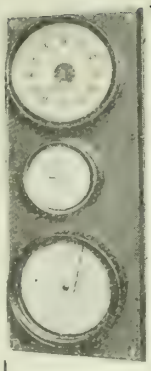
. . . The Columbia Basin scheme is utterly impracticable. Two-thirds of its alleged reclaimable lands this newspaper, which is familiar with them, would not take as a free gift. . . And yet this white elephant thing is dragged in everywhere. . . The fatuousness of some of these boosters and the childlike faith in their absurd chatter . . . etc."

A more moderate tone is exemplified by the Chehalis *Advocate*: "This paper has found itself in somewhat of a minority on this side of the state because it was reluctant to endorse the Columbia Basin project as outlined at present.

"The Columbia Basin project will come in time but a somewhat intimate knowledge of conditions in irrigated districts, leads us to the very positive hope that it will not be started until demand comes from those who want to farm the land and know the cost of so-doing, rather than from those who will simply farm the farmers.

"Let the work in behalf of the project continue, but let it be constructive, designed to aid the man on the farm solely, and the rest of us will receive the aid we deserve."

LOS ANGELES.—City Council of Los Angeles has passed a resolution urging President Coolidge to make definite recommendation to Congress in his next message, urging federal development of the Colorado River.



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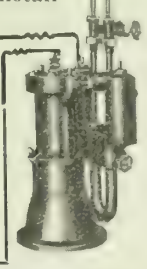

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55,000,000 G.P.D. for Lindsay-Strathmore Irrigation District.
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WHO'S *WHO* AND WHO'S *WHERE*

IN IRRIGATION AND RECLAMATION

Personal Notes and Impersonal Observations About Men You Know

William Spry, commissioner of the United States Land office, and former governor of Utah, spent part of September in Los Angeles. He has just completed a tour of land offices which were consolidated by the recent reorganization of his bureau.

O. S. Fisher, federal extension agronomist, is spending two weeks in Arizona, during which he plans to visit typical irrigated farms in all sections of the state. He is making the tour in company with Byron J. Showers, agronomy specialist of the University of Arizona.

New directors were elected in September by the Palo Verde Irrigation District, as follows: R. H. Ehlers, W. F. Mackey, and A. F. Masterman. Mr. Mackey is a prominent rancher in the Palo Verde Valley, and the other two members are bankers in Blythe.

A. L. Bailey, assistant city engineer of Los Angeles, recently returned from an inspection trip of the work being done on the survey for the Los Angeles Colorado River aqueduct. Surveyors are at work near Beaumont under the direction of Ralph Hamilton and C. A. Pond. Mr. Bailey reported that the work was proceeding excellently.

Members of the Los Angeles city council took advantage of an invitation to inspect the work going on at the Pacoima Dam in the Pacoima Canyon, and made a visit to the dam site on October 3. Those who relished aerial transportation were swung across the canyon in a cage supported on a cable 475 feet above the floor of the canyon.

Judge Frank O. Smith, of Phoenix, Arizona, was recently elected president of the Phoenix Chamber of Commerce. Declaring the purposes of the chamber, he stated on taking office that one of his first objectives as president would be to work for prompt action on the development of the Paradise-Verde irrigation and power project, under which a big tract of land "at the doors of Phoenix" will be opened for settlement.

R. H. Ballard, executive vice-president and general manager of the Southern California Edison Company, addressed the California Real Estate Association, in session during October at Fresno, California, on the subject of the relation of hydro-electric developments to real estate sales. He predicted that development of the Colorado River would permit of a population of 30,000,000 people in the southwest.

H. S. McCluskey, personal representative of Governor George W. P. Hunt, of Arizona, addressed a meeting of the City Club of Los Angeles during October, during which he reviewed the controversy between the various states interested in developing the Colorado River and outlined the policies of Governor Hunt, as Arizona's official spokesman, which govern his attitude toward the proposed developments.

S. H. Hopkins, of Wyoming; D. E. Carpenter, Colorado, and William R. Wallace and George M. Bacon, of Utah, water commissioners of their respective states, were in California during September, conferring with state officials on aspects of the Colorado River problem. They were in conference with Governor Richardson at Sacramento, and with Los Angeles officials and members of the California legislative investigating committee during the coruse of their visit.

Senator Oddie of Nevada, Senator Stanfield of Oregon, and Senator Cameron of Arizona, members of the United States Senate Committee on Public Lands, were in Southern California late in September holding hearings on various questions concerning the public lands policies of the government. At the committee's open hearing in Los Angeles, fires in national forests, grazing on public lands, watershed protection in the southwest, and similar questions were discussed. The committee is holding similar hearings in various parts of the west.

Arthur S. Bent, of Los Angeles, will head a delegation of Southern Californians to the Seattle meeting of the Chamber of Commerce of the United States, December 7 and 8. Mr. Bent is chairman of the program committee and a director of the national commercial body, and a vice-president of the Los Angeles Chamber of Commerce. As president of Bent Brothers, well-known construction engineers and contractors, he is prominent in the irrigation industry. Problems of water conservation and flood control in the eleven western states will be discussed.

An organization of sanitary engineers, conservationists and reclamation engineers was formed in September at Dallas, Texas, committed to the task of purifying the Trinity River and the conservation of its flood waters. More than 150 engineers met at the call of Mayor Louis Blaylock, of Dallas, and formed a permanent organization, to be known as the Trinity River Reclamation and Conservation Association. Officers were elected as follows: T. H. Harbin, of Dallas, President; John J. Simmons, Dallas, first vice-president; W. C. Weeks, Tarrant County, second vice-president; O. E. Carr, Fort Worth, third vice-president; J. E. Surratt, Dallas, fourth vice-president; E. J. Noyes, Dallas, secretary and treasurer.

After a tour of the Kittitas Valley and the site of the future Kittitas high-line canal, Congressman Louis C. Crampton, of Michigan, member of the House Committee on Appropriations, and chairman of the subcommittee on Interior Department deficiencies, left for Ranier National Park with an expression of great satisfaction at the conditions observed. Congressman Burton L. French, of Moscow, Idaho, also a member of the subcommittee, Congressman Addison T. Smith, of Twin Falls, Idaho, and John W. Summers, of Washington, D. C., accompanied Mr. Crampton on his visit. The congressional party was conducted over the valley by F. A. Kern, Ora McDermith, Bruce Bonney, and J. L. Lytel, prominent figures in Washington reclamation circles.

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RECLAMATION

NEW REGULATIONS ISSUED FOR SELECTION OF SETTLERS

REGULATIONS for the selection of settlers on Federal irrigation projects, in accordance with the terms of the reclamation law enacted by Congress in 1924, have been approved by Secretary Work and will be put into effect.

The regulations provide that applicants for irrigated farms must be in vigorous health with a minimum capital of $2,000 or its equivalent in farm equipment or live stock, and have at least two years actual experience in farm work. They also provide for the appointment on each Federal reclamation project of a local Examining Board of three or more members upon which will be vested the duty of selecting the best qualified applicants for all farm units available for settlement. The regulations provide, in part:

"Hereafter no entry for public lands within a Federal irrigation project shall be accepted by the local land office until the applicant therefor has satisfied an Examining Board, to be appointed on each project to consider such matters, that he is possessed of such qualifications (in addition to the qualifications required under the homestead laws) as to industry, experience, character, and capital, as in the opinion of the Board are necessary to give reasonable assurance of success by the prospective settler.

"Each applicant for entry of such public lands, including preference right ex-service men, and successful contestants under the act of May 14, 1880 (21 Stat., 140), shall file an application with the Bureau of Reclamation which, among other things, must state with respect to the applicant, his or her age, status as to citizenship, whether married or single, number of children, and their sex and ages, other dependents, ownership of farm lands elsewhere and the value thereof, farming experience, assets and liabilities, and give references as to character and industry. The application may state the particular farm unit desired and may also include a second and third choice and, when practicable, the choice of a fully qualified applicant will be approved. However, the intent of the law is to select the best qualified applicants for all farms available and the government must therefore reserve the right to distribute the farms to those best qualified, regardless of individual preferences.

"APPLICANT must possess good health and vigor and have had at least two years actual experience in farm work and farm practice. The applicant must have at least 2,000 in money, free of liability, or the equivalent thereof in live stock, farming equipment, or other assets deemed by the Examining Board to be as useful to the said applicant as money.

"The above minimum requirement as to capital and experience shall not apply when the farm (fractional farm unit) applied for is 10 acres or less in area and the applicant can show to the satisfaction of the Examining Board that the development of the farm is feasible from the capital the applicant may reasonably be expected to obtain as a wage-earner.

"An Examining Board of three members, or more, shall be appointed on each project by the Secretary of the Interior, or such officier as he shall authorize to make such appointments, to consider the fitness of applicants to undertake the development and operation of a farm. The members of such Board shall serve for a period of one year, or until their successors are appointed, unless otherwise ordered by the Secretary or such officer as he shall authorize to make such appointments. Each superintendent is requested to submit recommendations for membership on the Board of Examiners for his project at the earliest practical date."

THE EXAMINING Board, it is provided, shall interview the applicants who appear before it, to determine the qualifications of prospective settlers. Careful investigation shall be made to verify statements and presentations made by applicants to the end that no misunderstanding may prevail either as to the applicant's fitness or his appreciation of the problems before him.

The Board's decision as to the relative qualification of each applicant, based upon a percentage rating of the elements of industry, experience, character, and capital, shall be final unless appeal from such decision be made to the Secretary of the Interior within 30 days from receipt of notice, and such appeal should be filed in the project office where the lands are situated.

The relative standing of applicants will be based upon a percentage rating, weighing industry, experience, character and capital according to the following scale:

Industry	*Per Cent*
Fair	5
Good	15
Excellent	25

Farm Experience	*Per Cent*
2 yrs. or more in East	15
2 yrs. or more in irrigation	25

Character	*Per Cent*
Fair	5
Good	15
Excellent	25

Capital	*Per Cent*
$2,000	15
3,000	20
5,000	25

Approval by the Board of an application, followed by the filing of water right or water-rental application, when either is provided for on the particular project involved, which feature the Board shall cover by appropriate notation on the application, will entitle the applicant to file homestead application at the designated local land office for the farm unit assigned to him.

These regulations relate in the main to the entry of vacant farm units upon existing projects and existing divisions thereof.

Each public notice or order opening new projects or new divisions, however, it is explained, will contain detailed instructions on the subject of the qualifications necessary for prospective entrymen and the procedure under which such qualifications will be determined.

The regulations were approved by the Secretary of the Interior on the recommendation of the Commissioner of Reclamation and the Commissioner of the General Land Office.

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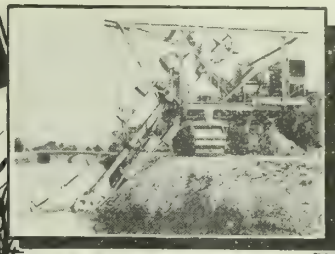
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IRRIGATION DISTRICT

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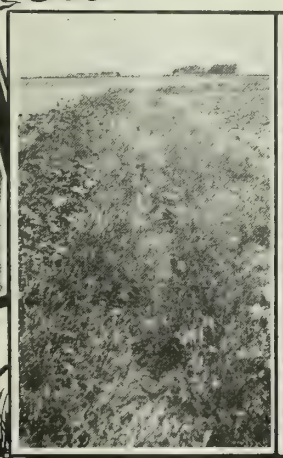

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YUMA, ARIZONA

U. S. BUREAU OF RECLAMATION
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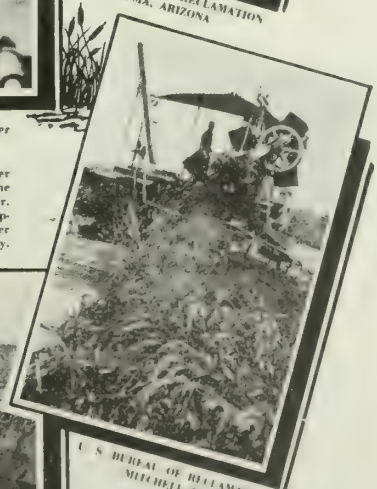
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The picture on the left above shows conditions that the usual dredger cannot hope to cope with, at Mitchell, Nebraska. The upper picture on the right shows the clean-cut ditch made by The Ruth Super Crawler Dredger. You will note in the picture the Ruth is still going through without any stoppage by growths of any kind, and it will be readily seen The Ruth Super Crawler Dredger works equally well in water as in dry earth, 'dobe or clay.

The Ruth Super Crawler Dredger Is Essential for the Economic Upkeep on All Reclamation Work.

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"We Seek Simply a Sound Economic System" Says Commissioner Mead

"AN ERRONEOUS impression seems to prevail," says Elwood Mead, Commissioner of the Bureau of Reclamation, "that there has been needless delay or opposition to carrying out Reclamation projects for which appropriations have been made by the last Congress."

Commissioner Mead further stated that the Reclamation Bureau desires to carry out the purposes of the Reclamation Act of December, 1924, and to build projects wherever a sound economic development is assured. It is unwilling, however, to begin the construction of any project until arrangements have been made which will comply with the law and insure contented and prosperous homes when those projects have been built. Continuing, he said:

"The situation on old projects, the investigations of the Fact Finders' Committee, and the hearings of the last congress make it evident that there had been too great haste in the past in beginning construction. Failure to settle in advance all the questions which a project presents has resulted in controversies with irrigators which embitter the relation of the government and water users after a lapse of 20 years. Another reason for care is the fact that construction costs of new projects are from two to three times what they were 15 years ago and when all the older projects were built. It becomes a serious question, therefore, whether the value of water in production will equal its cost and this needs to be carefully studied. The great war has doubled the cost of improving and equipping farms and it is necessary that settlers be informed of the capital they will require and that conditions necessary to enable them to make a comfortable living and repay the money invested by the government be provided.

"The greater part of the land on new projects is privately owned. Some owners hold large tracts. The law requires that these owners shall organize irrigation districts and shall contract to repay the government all the money spent and that the land they hold in excess of a homestead shall be appraised and the price at which it shall be sold to settlers shall be fixed. Negotiations to perfect these arrangements take time.

IN SOME cases, delays are due to the people most concerned. The Salt Lake basin project in Utah is an illustration of this. The government has had its plans and estimates for this work ready for months. The land that is to be irrigated is all settled and the farms on which it is to be used are highly improved but they have an inadequate water supply from private ditches. The price to be paid for water is satisfactory, but the local organization, which includes some of the ablest business men in the state, has not been able to organize the water users and make the necessary financial arrangements to insure the repayment of $3,000,000 that the works will cost. Like prudent men, they are taking time to determine what they ought to do. The Bureau is willing for them to take this time but desires the public to understand the causes of the delay.

"On the Vale, Oregon, project the contract for the purchase of water may have to be confirmed by the courts before the money is paid and construction begins.

"Because of the high construction costs of these new projects, which are the highest of any government irrigation works in any country, Congress required in the appropriations for four projects that the state should undertake the settlement of the land and help finance the development of farms. None of the states in which these projects are located has as yet seen its way clear to assume this financial responsibility.

"It is believed that an understanding of conditions on old projects and the problems which confront new ones will justify the actions of the Bureau in its efforts to place the operation of old works and the development of new ones on a sound economic basis. With such understanding and the cooperation of Congress and local interests, plans now so well under way will insure without interruption the irrigation development of the West."

Survey New Mexico Stream

Acting under authorization by the 1925 legislature, the office of the state engineer of New Mexico has begun a preliminary survey of the Gila River, in Grant and Hidalgo counties, with a view to utilizing these waters for the irrigation of lands adjacent to the river. The sum of $10,000 was appropriated by the legislature, and engineers from Santa Fe are now in the field making the survey. Storage reservoir sites, their potential capacities, and the amount of sub-surface water available, will be investigated and borings made for dam sites.

For Detailed Listings, Branch Offices, Etc., See the Buyers' Guide to Leading Supply Sources—Pages 55-56

The Columbia Basin League's Aims and Ambitions

(Continued from Page 16)

of supplying water. The State Department of Conservation and Development, through power given it by the state constitution and the land settlement act, is prepared to take necessary action to prevent speculation and exploitation of the settler on Columbia Basin lands.

"It is highly desirable that the project lands shall be placed in the hands of owners rather than renters. On the 80-acre unit plan of dividing the project, the area will provide 24,000 farms, supporting a rural population of at least 120,000, and a similar population increase in cities and towns developed on the area. The benefits to cities outside of the project will assure a total increased population to the Pacific Northwest of half a million people."

In addition to irrigation possibilities the project also has large power possibilities.

ALONG the distribution canals are numerous drops where power can be developed. On the project 30 such power sites were selected by the engineers as practicable. The combined installed capacity of the 30 plants is 145,000 horsepower. The average cost is $58 per horsepower. Two of these plants will furnish all the power required for secondary pumping.

"When, and as, these power possibilities are developed the net returns from power sales should be applied to the retirement of the capital cost of the project," says the government engineering report, which places the total construction cost at $295,000,000.

Before government engineers made a complete investigation of the project, General George W. Goethals of Panama Canal fame was induced by the Columbia Basin Irrigation League to make a study of the proposed project. One paragraph of the general's report gives a concrete idea of his opinion.

"Though located in the state of Washington, the benefits from the Columbia Basin project will not be confined thereto, but will extend to all parts of the United States. Through it pace will be kept with the ever-increasing demand for food stuffs of all kinds. It required vision to conceive the project; far less imagination was needed to picture the benefits that will accrue to the entire country through its realization."

Irrigation is permitted on the Elephant Butte, New Mexico district, during the last fifteen days of the month only, during October, November and December.

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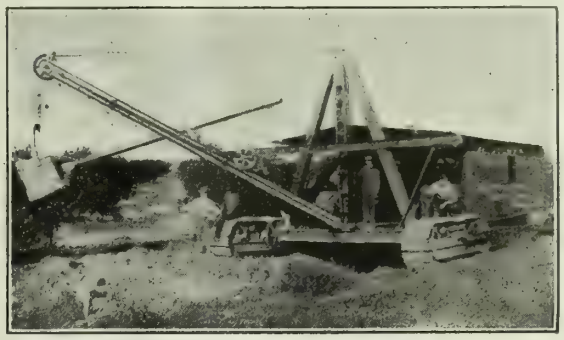
BAY CITY Land Dredges span the ditch, can dig any desired slope, and dump waste on both banks. BAY CITIES leave clean, wide berms, and can work up or down streams. One trip over the ditch is enough. The Shovel Type Dipper handles hard material in which other types of buckets cannot make a good showing.



At left—One yard BAY CITY Dredge digging and cleaning ditches in Florida Citrus Groves.

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or --- Model 4 Excavator

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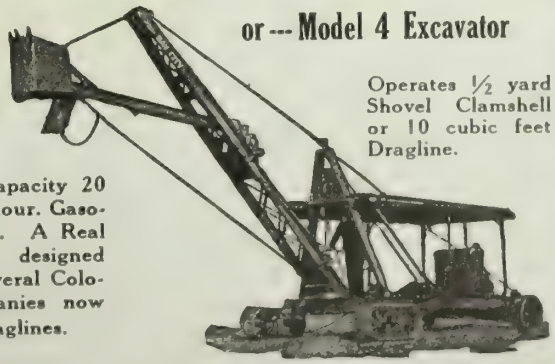

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IRRIGATION FINANCE

CREDIT MAKES OR BREAKS AN IRRIGATION DISTRICT

By JOHN DWIGHT NEALE

THE bright star of future greatness, for Western America, lies not in her mines, her forests, her fisheries, her oil fields, her commerce, or her industries. They are all of much importance, but must be supplemented and sustained by an irrigated agriculture.

It therefore is evident to thinking people that definite reclamation policies for Western America should be outlined and followed; that credit for irrigation financing must be created and conserved.

Changing national or state administrations should not affect reclamation policies. The idea of one administration making political thunder by criticism of its predecessor's reclamation record is a great business and credit mistake and, pursued for a time, ruins the credit of all irrigation undertakings, regardless of their merits.

WHEN the irrigation bond holder hears the uproar, smells the brimstone stirred by the muck-rake and views the political carnage, as set forth by a press anxious to publish "news" from the seat of action, he does not know it is only a "game of politics." He thinks it is "real stuff." He takes at face value what he reads and hears. He believes the bottom has fallen out of irrigation ditches, reservoirs and bonds.

He believes that the bond dealer who sold him the bonds lied when he told him irrigation was a constructive work, making two blades of grass grow where one or none grew before. He has little opportunity to obtain the facts surrounding the situation; therefore, he hastens back to the bond dealer from whom he purchased the irrigation bonds and tries to sell them.

By this time, the bond dealer has had so much difficulty in endeavoring to keep old customers sold on the issue and new customers found for the bonds he buys back, that he, too, believes that State a good one to avoid in future credit extensions.

Thus, the credit of irrigation districts suffers and with it every borrower in the state where it is located.

HERE are a few examples of how a poor credit rating affects the whole, when a part, for a time, has an unfavorable reputation:

Certain states of the union, for a given reason, about 60 years ago saw fit to repudiate a part or the whole of their state debts. Some cities have done likewise. The summer suns and the winter winds of 60 years have not yet entirely dissipated the unfavorable credit reputation which every municipality within those states gained through this unwise action.

THIS article consists of selected excerpts from a very comprehensive paper on "The Effect of Credit on Irrigation Development," read before the Oregon Irrigation Congress by the author, John Dwight Neale. Mr. Neale is connected with the J. R. Mason Company, of San Francisco, specializing in irrigation securities; and he is the author of several well-known treatises on various financial aspects of reclamation and irrigation. Mr. Neale expects to publish the entire paper, of which this article is a part, in booklet form.

The sums avoided and the debts evaded were a bagetelle compared to the added rates paid, and the premiums missed, during all of these years, whenever any political subdivision of such a state sought outside credit from money centers.

The Book of Proverbs says: "A good name is rather to be chosen than great riches and loving favor rather than silver and gold." This shows that the value of good credit ratings was fully appreciated in ancient times.

Cities issue what are termed Improvement District Bonds. They are usually obligations of the District or of the proptery affected, but ostensibly obligations of the city. About fifteen years ago the Supreme Court of Oregon held that these bonds are obligations of the city, and the "Bancroft Act" bonds, issued under this decision and law, are payable from the city treasury while the city, in turn, collects from the property benefitted.

The effect of this wise interpretation has saved Oregon towns and cities hundreds of thousands, if not millions of dollars. These one to ten-year installment payment 6 per cent bonds have sold at substantial premiums, practically all the time, regardless of the investment market. I have presented bids on these bonds to bring the rate down to 5 per cent to the city.

I have never seen an instance in Oregon where a town could not sell its Improvement Bonds. This illustrates what a "good name" will do for a state and its people.

I HAVE heard that in a neighboring state to Oregon a court decision was at one time rendered, explicitly inhibiting the payment of Improvement District Bonds from the city's general treasury, which, if true, practically means that the bond holder is told to collect from each individual piece of property within the District, or lose his money. The credit results of such an interpretation certainly could not have been foreseen by its proponents.

City improvement district financing of that state has cost terrific penalties—seven per cent bonds turned to contractors have, in turn, been sold by the contractors at very heavy discounts.

It doesn't take many bad moves nor very long for an individual or a state to lose its good name and its credit.

ABOUT twenty years ago a neighboring state to Oregon, almost wholly dependent upon irrigation for

agricultural growth, developed a great wave of reclamation enthusiasm. It seemed so reasonable and economically sound a principle that big business and big bankers of the eastern credit centers brought large sums of money into that state with which to carry on reclamation work.

Some of the enterprises were wisely planned and honestly and ably completed. They were a great success and the bond holders had their interest and principal paid promptly when due.

Other enterprises were less fortunate. They caused some loss to bond holders and inestimable loss to the state. Little new development was possible for a dozen years, because irrigation securities had no credit standing. The population of that state advanced but very little in a decade. Every borrower in the state was affected adversely when he sought large credit in money centers.

Time heals many wounds and gives opportunity for the birth of a new and credulous class of bond dealers and investors. Therefore, about a half dozen years ago numerous irrigation districts began to be formed to take over the old enterprises or to create new ones.

Certain bond dealers began again gradually to approach irrigation securities of that state, the examples of great success where irrigation had been practiced were so apparent, and the purposes and promises of the promoters so plausible, that they were led forward again to the business of gradually opening up the resources of the state for the use of many, through the extension of credit to its irrigation districts.

IT BEGAN to look like that state would again soon be able to demand credit as required on its irrigation district bonds.

Then some reaction in the price of farm crops came along and irrigation district bonds, in numerous localities, throughout that state, began to go into default.

The immediate result of this last unfortunate experience may readily be seen —viz: the almost utter collapse of a secondary market for any of the outstanding bonds and the slipping back into the dark ages of history for irrigation district credit in the minds of numerous well-intentioned bond dealers and investors who really had an honest purpose and a worthy vision in extending credit to them.

I personally know conditions in that state well, and believe that this last credit collapse of many irrigation districts was unnecessary and will hold back development there for a generation. If the credit position of these defaulting districts had been maintained by the state itself, if necessary, millions of capital and thousands of people would, in my judgment, have been interested in going into new irrigated areas, and in driving the desert back, through the building up of farm homes.

IRRIGATION has placed California at the head of all western states in value of crop production and very near the top in the entire nation. It has been the chief factor in the rapid increase of her population during the last decade for, after all, "climate" alone does not attract people in large numbers to live in a desert.

Los Angeles County's climate, mixed with irrigation water, has placed that county at the head of all counties in the United States in the annual value of crops produced. California's future growth in financial importance and in population is only limited by her ability to gradually cover many more millions of acres of land with irrigation water and to reduce the units of land ownership to the point of greatest economic and social advantage.

In the early history of irrigation development in California some unfortunate projects were undertaken and some loss ensued.

The results affected development of irrigation in the state for many years, and only since a new law and an awakened consciousness of what irrigation means to an arid state has the real development of California taken place. California will never suffer the credit position of her irrigation securities to be seriously impaired again, as the $200,000,000 now invested in irrigation development within the state is less than the average value of one year's single crop raised by irrigation.

Moreno Bonds Approved

The way was opened for the sale of $175,000 in bonds issued by the Moreno Mutual Irrigation Company (California) by the decision of the California Supreme Court, given during September, that the bonds had been legally issued. The bonds were held up by the California Secretary of State on the ground that the directors had not met in the proper place when they passed the resolution authorizing the bond issue. The company was successful in getting the supreme court to assume direct jurisdiction in the case, and were vindicated by its decision. Money from the sale of the bonds is to be used for the installation of 33,000 feet of pipe-line, reservoirs and a distributing system.

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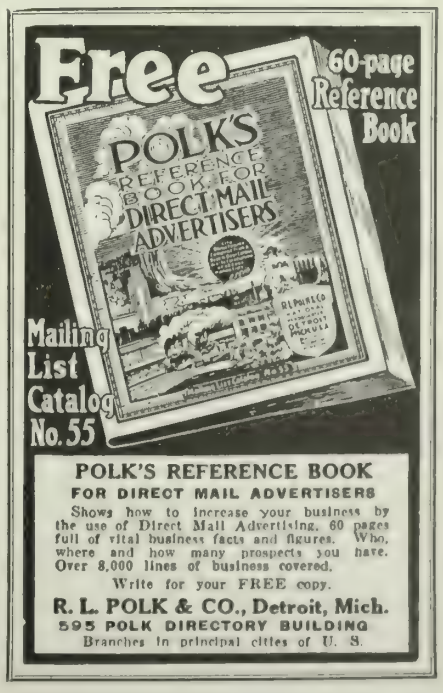

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SAN FRANCISCO

Equipment Dealers Face Problem in Handling Used Pumps

(*Continued from Page 19*)

wants to make the sale, and he finally plunges the extra $160. Perhaps he figures that some of the random-length pipe or the rusted fittings can be used in some way which, up to the present, he has never discovered. He forgets that, at one-half cent per pound, junk price, it would take a considerable tonnage of pipe and fittings to total up $160.

"We can't blame either one of these men. Certainly the irrigator isn't at fault in wanting the best possible terms. The purchaser of pumping equipment is merely proceeding along the lines that have been laid down for him by all too many manufacturers and dealers with whom he has come in contact. He doesn't know that Johnson is sacrificing his legitimate profit to make the sale. He merely knows that he gets a better price if he lets the dealers bid against each other.

"The irrigation equipment industry is, itself, at fault in this matter. It does not present a united front, and, until such time as it does, the dark shadow of the sheriff will hover over many a threshold, and the closing chapter to the story of numerous supply ventures will be written on a legal form supplied by the county."

This is the problem that has proved such a trying one to the Western Irrigation Equipment Association. Its members believe that it is taking steps in the direction of its solution in presenting the recommendations that have been decided upon by its committee.

THE Association's committee recognizes, of course, that there are instances where it would be not only unjust, but economically unsound business practice, to refuse to make a good allowance on equipment that has been used, and which, for special reasons, must be disposed of while there is still a long period of useful service to be obtained from it.

Some of the most noteworthy examples of this are easily pointed out. Pumps are sometimes purchased for use on land that normally has a high water table, and after the equipment has been installed, the water sinks to a level that makes it necessary to replace horizontal pumps with deep well types. Or, perhaps, a well is judged capable of handling a ten inch pump, but after a short time it is found that it will have to be replaced by a smaller size in the interest of most economical operation.

If all of this equipment were left on the hands of the irrigators, it would work untold hardships on them as individuals, sometimes as whole districts. The necessity here arises to find some way to take in this material, appraising it at its full value, and make it available for use in other territories, or on other projects, where it can serve out its period of maximum usefulness.

This solution lies in the hands of the dealers, declare the Association's leaders. There is an ethical and legitimate demand for second-hand or slightly used equipment in the irrigation industry. And if the purchaser feels he must have used equipment, quite likely he will follow his inclination and purchase what he wants, arguments in favor of new pumps notwithstanding. It is better, then, since this trade exists and will probably continue to exist, that it go through the regular legitimate channels of trade.

BUT the committee would emphasize that dealers who decide to engage in this phase of merchandising must be doubly cautious, lest they be caught unawares. They must realize that trade-in equipment may never be salable in their own immediate territory again, and accordingly should have means of disposing of it in other fields. They must be cautious that they do not, by dumping used equipment on their own market, demoralize it, and disrupt the regular demand for new goods.

"Second-hand" does not mean junk. A second hand pump is a piece of equipment. Second hand pipe and fittings are junk, and should not be bid in except on that basis. (This does, of course, refer to re-conditioned pipe, which should be classed with factory re-built merchandise.)

The whole plan, to be made operative, hinges on two things, however, it is believed. The manufacturer must not take back any equipment whatsoever for the purpose of stimulating sales, and the dealers must refuse absolutely and in every instance to make any concessions beyond the second-hand resale value of the article.

The magnitude of the irrigation industry is only beginning to be realized, and as the industry grows, the pump industry, an essential and integral part of irrigation, must also grow. But no industry has ever been known to thrive on red ink balances in the ledger, and no individual has ever been known to squeeze through the gates of the Hall of Fame on business "done for fun."

For Detailed Listings, Branch Offices, Etc., See the Buyers' Guide to Leading Supply Sources—Pages 55-56

A $300,000,000 Project

may stagger the imagination of one who is not intimately in touch with hydro-engineering activity of Western America.

Yet this gigantic enterprise is but one of many under contemplation, at this time, in the field and market covered by MODERN IRRIGATION. Not nebulous schemes of promoters and visionaries, by any means, but projects that have been surveyed and approved by engineers of international repute.

In 1920 irrigation, drainage and excavating contracts exceeding $25,000 amounted to only $16,220,000 in the United States while "water works" contracts, so called, in that same year, totaled approximately $30,000,000. In 1924 irrigation and drainage contracts (over $25,000) had increased to $48,147,000—upon competent authority—while "water works" contracts had mounted to a total of $65,453,000 for the year.* At this writing, several water development projects are pending in the irrigation country of the west, any *one* of which, when carried out, *will exceed in cost the grand total of all contracts of like character awarded in 1924.*

"The Western country of America," said an eminent engineer recently, "will, in the coming few years, see the greatest engineering developments the world has ever known." MODERN IRRIGATION expects to have an active participation in these nation-building enterprises. As the editorial voice of the reclamation movement and the recognized clearing house of information upon every phase of hydraulic activity, it will be in a position to wield a unique influence—a fact that far-sighted advertisers have already been quick to grasp and to capitalize.

The time to identify yourself, and your concern, with MODERN IRRIGATION and the principles which it stands for is *now*. There is, too, a distinct advantage to be gained by doing so.

*To these figures should be added approximately 100 per cent to give a total of all contracts, of this character, awarded in the U. S., including much work done by hired labor direct, which is not covered by these statistics.

For Detailed Listings, Branch Offices, Etc., See the Buyers' Guide to Leading Supply Sources—Pages 55-56

OVERHEAD IRRIGATION

NO, THE OVERHEAD ENGINEER ISN'T AN AVIATOR

By HUGH CRANE

INTRODUCING irrigation's newest division of labor—the overhead irrigation engineer. He's not simply one of the better known kind of irrigation engineer who has taken up flying, either. He is one who specializes—exclusively—on the work of applying the science of overhead sprinkling to the orchard.

I had a talk this morning with Albert E. Harris, specialist in overhead irrigation and pressure water systems, a representative of the new profession.

"There's more to it," said Mr. Harris, "than one might imagine. Casually, one might think that it meant merely the cutting up of a few odd lengths of pipe, the installation of sprinklers at proper intervals, and then turning the water on. It can't be done that way. The engineer who specializes in this branch of the work must know trees and soils, first, for an understanding of their requirements and their behavior under varying conditions; second, he must know materials, both from an engineering point of view and from a commercial point of view; and, of course, for success, he must thoroughly know men, for he must meet men as clients and potential clients, and must handle men in getting all branches of his work accomplished.

"He must bring together in use the products of three large and complicated industries, each of which has independently advanced to a point undreamed of by those not in actual touch with them. The first is the great pump industry—he must know pressure problems, and have a wide acquaintance with pumps and their manufacturers. The second is the sprinkler industry—not so large, but in itself a very considerable business. The third is the pipe industry — he must know in detail the theory and practice of pipes and hydraulics. All this calls for a wide variety of practical and technical knowledge."

SEVERAL integral steps," Mr. Harris says, "must have their due place in any given job that the overhead irrigation engineer takes up. The first is to make a complete engineering survey of the problem. Having been called in by a rancher and asked to figure on installing an overhead system on a tract of forty acres, for instance, the engineer can not take a quick glance at the property, jot a logarithm or two on his cuff, and name a price. His method of procedure is first, to make a field reconnaisance of the land in person, taking into due account such conditions as the abutting property, prevailing winds, and other similar matters which do not bother the draftsman because they don't exist on the drawing board, but often do annoy the overhead irrigator signally when his system is installed and operating. Then, with contours and complete data on the soil conditions, spacing of trees and tree-tops, he completes his estimate of the job and submits it to the owner."

ALBERT E. HARRIS

The cost does not depend on the acreage alone. It will be determined very largely on such factors as the pressure desired, the amount of water to be delivered, the arrangement of trees, and the availability of an adequate water supply.

If the estimate is approved, the next step is still another technical matter, calling for the skill of the engineer and his assistants. An engineering layout of the property is made to guide the installation of the system.

This layout is supplemented with complete engineering specifications and the necessary agreements between the contractor and the owner. Checked up and approved, it forms the basis for the next step, which is the actual construction work.

MR. HARRIS now has twenty-four men working for him, including both his draughting department and his construction workmen. They can handle, if pushed to capacity, about three acres a day. With the addition of three more men, he declares, he would be able to handle five acres per day of installation. A big gang, trained for rapid work, is necessary because installations must be completed in the interval between irrigations. A recent installation on a forty-acre tract was finished in twenty-four days.

"How did you become interested in taking up this particular branch of the business?" I asked Mr. Harris.

"For a number of years I have been working with hydraulic problems, in the pump business," he replied, "but the thing that first attracted my attention to the potentialities of the overhead sprinkler systems for orchards was the benefits possible thereunder in frost protection. I remember, when I was a child, seeing my grandmother ward off frost damage by sprinkling her tender and cherished plants outside the door with a watering pot. I was familiar, too, with some of the common phenomena connected with

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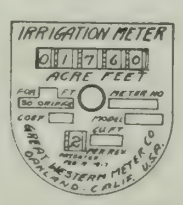

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frost protection on a larger scale by making use of the same principle. After some disastrous freezes in Southern California, I began investigating the practical possibilities of adapting this method to citrus growing.

"Out of these investigations there came wider familiarity with sprinklers and sprinkling systems, and I found to my surprise that the frost protection aspect, while undoubtedly an important one, doesn't represent more than two per cent of the benefits to be derived from 'overhead'. And so I entered the business."

SOME of the jobs which Mr. Harris has recently completed or is now working on include some fine examples of citrus properties, and will afford splendid opportunities to make accurate check on the results of overhead irrigation as compared with former methods.

He is now beginning the actual installation work on a 40-acre tract of citrus at Glendora, California, owned by W. E. Glidden, wealthy resident of Beverly Hills.

He is also working on an installation for a ten-acre tract at Glendora for C. M. Johnston. Mr. Johnston's ten acres of citrus are all "pedigreed trees", and supply bud stock for some of the finest trees in Southern California. Complete individual tree performance records are kept on this ranch,, and within a short time will reveal, undoubtedly, interesting data on performance under overhead irrigation.

Several other Glendora citrus ranchers have seen examples of Mr. Harris' work and have given him contracts on their ranches. One of these was for 7 acres for E. C. LaFetra. Frank H. Browne is having an installation put in on ten acres. H. C. Warren and Henry King recently had small acreage converted to "overhead". C. G. Washburn has ten acres fitted out with the artificial rain. W. L. Downes, six acres, and Harry Beckwith, 12 acres, are other Glendora growers who have called in the rainmaker, new variety.

Dr. Vincent Baker, of La Verne, has recently installed overhead on 10 acres and plans to apply the new system to forty acres more. H. B. Jones of Claremont has ten acres so equipped. This ranch is an interesting one because it recently won high honors for its lemons at the Southern California fair, and it irrigates three times a month, on account of the unusual thinness of the soil. "Mr. Jones' land," said Mr. Harris, "has a soil of only about eighteen inches in depth. On such soil overhead sprinkling is the rancher's salvation, and irrigation is practically continuous there."

For Detailed Listings, Branch Offices, Etc., See the Buyers' Guide to Leading Supply Sources—Pages 55-56

W. I. E. A. Elects Officers

(*Continued from Page 12*)

greatest needs. Our agreeable contact with the new and up-to-date publication MODERN IRRIGATION should assist us greatly and we should assist it and ourselves by working for its wider circulation.

"Yet another method of spreading our message would be through a wider circulation of our data book. We have requests from all over the country for this data book, but our aim is to supply reliable information to irrigation interests in our own territory.

"In conclusion, your president extends his sincere thanks for the past year of individual and cooperative effort for the common good and hopes that such effort and interest may continue and increase."

OF SPECIAL interest to the Association is the work being carried on by a joint committee composed of members of the W. I. E. A. and the California Committee on the Relation of Electricity to Agriculture. This committee is occupying itself at present with the task of working out a standard guarantee that will be satisfactory and fair to both manufacturers and consumers. To date only tentative recommendations have been made but they show, in the main, several policies that will serve as a guide in the formation of the new standard form of guarantee.

Among other things, it is to be recommended that the users have their wells tested before buying any pumping equipment. This, in itself, if it becomes a universal practice, will do away with much of the controversy over so called non-fulfillment of guarantee. Ten percent leeway is to be allowed the manufacturer on his pump rating where a test is made.

Tests must be demanded by the user within ten days after installation, and they will be made by a neutral third party, according to the present plans. The cost of the test is to be borne by the manufacturer of the pump if his equipment fails to prove up to rating, and by the purchaser if it shows the guaranteed volume of water. Changes will be made in these plans, and the committee emphasized that they must not be considered final. They are merely intended to show the general lines that the recommendations will follow.

The evening banquet of the Association was an unqualified success, with Milton Ferguson, State Librarian, acting as toastmaster, and J. E. Huntoon, president of the People's Bank, Sacramento, and president of the California Bankers Association, as the principal speaker.

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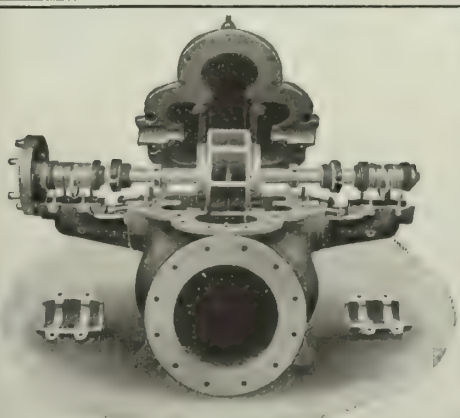

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SURVEY *of* IRRIGATION DEVELOPMENT

As Shown by Official Records of the Month -- Local, State, and Governmental

RECORDS SHOW LARGE DEVELOPMENTS ARE PENDING

AMONG the more important permits to appropriate water issued by the Department of Public Works, Division of Water Rights of California, during the month of August, 1925, were the following:

Permit No. 2184, Application No. 4153 (Siskiyou County). Issued to Joe Franklin, John and Joe Quadros, Ager, California, August 8, 1925, for 2.80 cubic feet per second from Bogus Creek in Sec. 13, T 47 N, R 5 W, for irrigation of 224 acres near point of diversion. Estimated cost $1000.

Permit No. 2187, Application No. 4464 (Sacramento County). Issued to Geo. M. Mott, Jr., Rio Linda, California, August 12, 1925, for 0.41 cubic foot per second from Linda or Dry Creek in Sec. 22, T 10 N, R 5 E, for irrigation of 33 acres in Sec. 22. Estimated cost $1500.

Permit No. 2190, Application No. 4312 ((Glenn County). Issued to Raymond Houx, Colusa, California, August 18, 1925, for 5.42 cubic feet per second from Sacramento River in Sec. 18, T 18 N, R 1 W, for irrigation of 216.8 acres near point of diversion. Estimated cost $4500.

Permit No. 2191, Application No. 4313 (Glenn County). Issued to Annie McVay et al, Butte City, California, August 18, 1925, for 2.70 cubic feet per second from Sacramento River in Sec. 18, T 18 N, R 1 W, for irrigation of 108 acres near point of diversion.

Permit No. 2192, Application No. 4314 (Glenn County). Issued to Arthur L. Kerr, et al, Oakland, California, August 18, 1925, for 4.48 cubic feet per second from Sacramento River in Sec. 18, T 18 N, R 1 W, for irrigation of 270 acres near point of diversion.

Permit No. 2193, Application No. 4315 (Glenn Count). Issued to Irwin N. McVay, Princeton, California, August 18, 1925, for 5.11 cubic feet per second from Sacramento River in Sec. 18, T 18 N, R 1 W, for irrigation of 204.6 acres near point of diversion.

Permit No. 2194, Application No. 4316 (Glenn County). Issued to Grace McVay and Virginia McVay, Berkeley, California, August 18, 1925, for 6.64 cubic feet per second from Sacramento River in Sec. 18, T 18 N, R 1 W, for irrigation of 265.8 acres near point of diversion.

Permit No. 2195, Application No. 4317 (Glenn County). Issued to Ernest I. Williams, Colusa, California, August 18, 1925, for 1.9 cubic feet per second from Sacramento River in Sec. 18, T 18 N, R 1 W, for irrigation of 76 acres near point of diversion.

Permit No. 2196, Application No. 4318 (Glenn County). Issued to Emil Jacobson, San Francisco, California, August 18, 1925, for 2.62 cubic feet per second from Sacramento River in Sec. 18, T 18 N, R 1 W, for irrigation of 105 acres near point of diversion.

Permit No. 2197, Application No. 4319 (Glenn County). Issued to Malvina E. Williams, Princeton, California, August 18, 1925, for 4.57 cubic feet per second from Sacramento River in Sec. 18, T 18 N, R 1 W, for irrigation of 192.7 acres near point of diversion.

Permit No. 2198, Application No. 4325 (Glenn County). Issued to Charles H. Williams, Princeton, California, August 18, 1925, for 0.87 cubic foot per second from Sacramento River in Sec. 18, T 18 N, R 1 W, for irrigation of 34.76 acres near point of diversion.

Permit No. 2199, Application No. 4326 (Glenn County). Issued to Walter G. and C. M. Reichel, Princeton, California, August 18, 1925, for 2.02 cubic feet per second from Sacramento River in Sec. 18, T 18 N, R 1 W, for irrigation of 120.9 acres near point of diversion.

Permit No. 2212, Application No. 4343 (San Diego County). Issued to Mary J. Wood, San Diego, California, August 20, 1925, for 1 cubic foot per second from underground water in Sec. 32, T 12 S, R 1 W, for irrigation of 90 acres near point of diversion. Estimated cost $5000.

Permit No. 2215, Application No. 4301 (Solano County). Issued to E. H. Wheeler, St. Helena, California, August 26, 1925, for 3.34 cubic feet per second from Miner Slough in Sec. 10, T 5 N, R 3 E, for irrigation of 267 acres near point of diversion. Estimated cost $1500.

Permit No. 2216, Application No. 3778 (Los Angeles County). Issued to B. F. Burkhart and Anna M. Burkhart, Littlerock, California, August 26, 1925, for 750 acre feet per annum from Middle Fork of Pallet Creek in Sec. 23, T 4 N, R 10 W, for domestic use and irrigation of 300 acres near point of diversion.

Permit No. 2218, Application No. 4161 (San Joaquin County). Issued to Mary Ives Crocker, San Francisco, California, August 28, 1925, for 3.8 cubic feet per second from Old River in Sec. 30, T 1 S, R 6 E, for irrigation of 305.98 acres near point of diversion. Estimated cost $12,000.

Applications Filed

Among the applications for permit to appropriate water filed with theState Department of Public Works, Division of Water Rights, (California) during the month of August were the following:

Application No. 4719 (Sutter County), Geo. E. Springer, 351 California street, San Francisco, California, for 1.0 cubic foot per second from Sacramento River tributary to Suisun Bay, to be diverted in Section 13, T 15 N, R 1 W, M. D. M. For irrigation on 80 acres. Estimated cost $54,500.00.

Application No. 4720 (San Luis Obispo County), Peterson Farms Company, 527-531 Consolidated Building, Los Angeles, California, for 2½ cubic feet per second and 398 acre feet per annum from Los Osos Creek, tributary to Pacific Ocean, to be diverted in Section 20, T 30 S, R 11 E, M. D. M., for irrigation of 200 acres in Rancho Los Osos. Estimated cost $2500.00.

Application No. 4721 (Orange County), Dana Point Syndicate, care of Charles G. Patrick, 403 S. Hill street, Los Angeles, California, for 30 cubic feet per second from San Juan Creek, tributary to Pacific Ocean, to be diverted in Section 14, T 8 S, R 8 W, S. B. M., for domestic and irrigation purposes at townsite of Dana Point and vicinity. Estimated cost $250,000.00.

Application No. 4730 (Lassen County), Jay C. Wemple, Milford, Lassen County, California, for 2.12 cubic feet per second and 200 acre feet per annum from (a) Mill Creek, (b) Dry Creek, tributary to Honey Lake, to be diverted in (a) and (b) Section 26, T 27 N, R 14 E, and (c) rediversion, Section 23, T 27 N, R 14 E, MDM for irrigation and stockwatering in Sections 23 and 24, T 27 N, R 14 E, M. D. M. Estimated cost $2500.00.

Application No. 4737 (Amador County), Stephen E. Kieffer, Mechanics Institute Building, San Francisco, Cal., for 200 cubic feet per second from Mokelumne River tributary to San Joaquin River, to be diverted in Section 22, T 5 N, R 10 E, M. D. M., for generation of hydro-electric energy. in Section 20, T 5 N, R 10 E, M. D. M.

Application No. 4738 (Colusa County), Martha Wackermann, care of C. D. McCormish, Colusa, California, for .61 cubic feet per second from Sacramento River, tributary to Suisun Bay, to be diverted in Section 26, T 14 N, R 1 E, M. D. M., for irrigation on 48-98 acres in Sections 26 and 27, T 14 N, R 1 E, M. D. M. Estimated cost $2000.00.

Application No. 4741 (Calaveras County), Calaveras Cement Company, 315 Montgomery stret, San Francisco, California, for 1.25 cubic feet per second from San Antone Creek, tributary to South Fork Calaveras River, to be diverted in Section 32, T 4 N, R 12 E, M. D. M. To be used for industrial and agricultural purposes in Section 29, T 4 N, R 12 E, M. D. M. Estimated cost $2000.00.

Application No. 4742 (Calaveras County), Calaveras Cement Company, 315 Montgomery street, San Francisco, California, for 1.25 cubic feet per second from Calaveritas Creek, tributary to South Fork Calaveras River, to be diverted in Section 29, T 4 N, R 12 E, M. D. M. To be used for industrial and agricultural purposes in Section 29, T 4 N, R 12 E, M. D. M. Eestimated cost $2000.00.

·SNOW·

IRRIGATION APPLIANCES

SNOW NO. 2 UNDER-ARCH ORCHARD VALVE

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Application No. 4743 (Sacramento County), Carmichael Irrigation District, care of Elliot and Atkinson, Mitau Building, Sacramento, California, for 10 cubic feet per second from American River, tributary to Sacramento River to be diverted in Section 22, T 9 N, R 6 E, M. D. M., for irrigation and domestic purposes on 1800 acres. Estimated cost $120,000.

Application No. 4744 (Siskiyou County), William B. McGill & Geo. A. Tebbe, Peters and Dewitt Bldg., Yroka, California, for 1.25 cubic feet per second from Buckhorn Creek, tributary to Klamath River, to be diverted in Section 23, T 47 N, R 10 W, M. D. M., for agricultural purposes on 111.1 acres.

Application No. 4750 (Plumas County), R. B. Swayne and J. N. Turner, care of R. B. Swayne, 201 Sansome street, San Francisco, for 10 cubic feet per second from Jameson Creek, tributary to Middle Fork of Feather River, to ze diverted in Section 25, T 22 N, R 11 E, M. D. M., for generation of hydro-electric energy in Section 7, T 22 N, R 12 E, and Sec. 31, T 23 N, R 12 E, M. D. M. Estimated cost $100,000.

Application No. 4751 (Riverside County), Palm Valley Water Company, care of A. Braunschweiger, 180 Elmwood Court, Riverside, California, for 900 acre feet per annum from Chino Creek, tributary to Whitewater River, to be diverted in Sec. 12, T 4 S, R 3 E, S. B. M., and Sec. 7, T 4 S, R 4 E, S. B. M., for municipal purposes in community of Palm Springs. Estimated cost $2500.

Application No. 4752 (Riverside County), Palm Valley Water Company, care of A. Braunschweiger, 180 Elmwood Court, Riverside, Calif., for 5 cubic feet per second from (1) Falls Creek, (2) Snow Creek, tributary to Whitewater River, to be diverted in (1) and (2) Sec. 33, T 3 S, R 3 E, S. B. M., for municipal purposes in community of Palm Springs. Estimated cost $81,000.

Application No. 4756 (Lake and Napa Counties), C. A. Tusch, 2211 Union street, Berkeley, Calif., for 400 cubic feet per second and 300,000 acre feet per annum from Putah Creek, tributary to Sacramento River, to be diverted in Sec. 29, T 8 N, R 2 W, M. D. M., and Sec. 13, T 11 N, R 6 W, M. D. M. for agricultural purposes.

Power Developments

Twenty applications for permit or license under the Federal water power act were filed with the Federal Power Commission during the seven weeks' period ended August 29, 1925, making a total of 645 applications received to that date. The following applications are those contemplating power developments in the western states:

No. 627—Charles A. Johnson has applied for a preliminary permit for a power project on Salt River, in Gila County, Arizona, about 20 miles north of Globe. A 15-foot diversion dam will be built about a mile west of the mouth of Hess Creek. The project includes a tunnel about seven miles long on the right bank of Salt River, a steel pipe line leading from the tunnel to a power house on the river, and a transmission line about 20 miles long from the power house to the Globe-Miami mining district. The power to be developed is intended for use in mining operations.

No. 629—The California-Oregon Power Company has applied for a license for a transmission line about three miles long, in Klamath County, Oregon.

No. 630—Mrs. Ida M. Butts has applied for a license for a small power plant in Eagle Creek, on the Holy Cross Reservation, in Colorado, from which power will be supplied for use in operating the applicant's mine.

No. 631—Messrs. Kumle and Kassalbaum have applied for a license for a transmission line about four miles long, in Yuba County, California.

No. 632—The municipality of Monroe City has applied for a license for a power project t boe located on Monroe Creek, Sevier County, Utah. The power developed is to be used for municipal purposes.

No. 633—Messrs. Swayne, Leland, and Turner have applied for a preliminary permit for a power project on Jameson Creek, near Johnsville and Blairsden, in Plumas County, California. The development will have four storage reservoirs and appurtenant structure obtaining water from Eureka Lake and Deer, Bear, Squirrel, and Poplar Creeks. The power developed will be used for public-utility purposes.

No. 637—The Chelan Electric Company has applied for a license for a power development in Chelan River, Chelan County, Washington. A dam with apurtenant structures will be built just below the town of Chelan, at the mouth of Chelan Lake. Approximately 50,000 horse-power, primary capacity, is to be developed and will be used for public-utility purposes.

No. 639—The Washington Water Power Company has applied for a license for a transmission line about five miles long in Shoshone County, Idaho.

Upon request of the applicants and of opposing interests in the State of Colorado, the final hearing before the Federal Power Commission upon the application of James B. Girand (project No. 121), for a license for a proposed power development on the Colorado River at Diamond Creek, tentatively set for the early part of September, has been postponed until October 20, 1925,. The hearing will be held at 2:30 p. m. in the office of the Secretary of War, State, War, and Navy Building, Washington, D. C. All objections received prior to October 20, or presented at the hearing will be considered by the Commission in taking action upon this apllication.

OREGON

The following list includes the more important applications as filed in the office of Rhea Luper, State Engineer, of Oregon, for the last month for which records are available:

Walter B. Beebe of Portland, covering the appropriation of water from North Fork of Yamhill River for storage in Westerlock Dam Reservoir, the impounded water is to be used for boating and irrigation purposes in Multnomah County.

B. F. Felger of Dallas, covering the appropriation of water from two unnamed streams for the irrigation of 10 acres and domestic purposes in Lincoln County.

F. A. Garde of Aumsville, covering the appropriation of water from South Beaver Creek for irrigation of 33 acres in Marion County.

F. A. Epling of LaGrande, covering the appropriation of water from springs for irrigation of 20 acres in Union County.

City of Gresham covering the appropriation of water from Heiney Sprnig and seepage from Gulch tributary of Willamette River for municipal supply for city of Gresham, in Multnomah County, at a cost of $15,000.

Charles H. Wikoff of Grants Pass, covering the appropriation of water from Spence Creek for irrigation of 40 acres in Josephine County, at a cost of $2,000.

S. E. McCoy of North Bend, covering the appropriation of water from Haines Inlet for irrigation of 60 acres in Coos County.

M. Tamura of Troutdale, covering the appropriation of water from Beaver Creek for irrigation of 20 acres in Multnomah County.

Cooper Anderson of Salt Lake City, Utah, covering the appropriation of water from an unnamed spring for domestic purposes, including stock water and irrigation of 100 acres in Washington County, Oregon, at a cost of $2,000.

G. F. McCurdy of Nyssa, covering the appropriation of water from Snake River for irrigation of 45.3 acres in Malheur County, at a cost of $1,174.

Harry L. Mills of Hildebrand, covering the appropriation of water from Buck Creek for irrigation of 41 acres in Klamath County.

F. S. McMahon Estate, Freewater, Oregon, covering the appropriation of water from S. E. ¼ N. E. ¼, Sec. 3, T 5 N, R 35 E, W. M., for supplemental irrigation of 10 acres in Umatilla County

Clear Lake Reservoir Company of Halfway, covering the appropriation of water stored in a reservoir on West Fork of Clear Creek for irrigation purposes in Baker County.

A. K. Chapman of Portland, covering the appropriation of water from Sandy River for development of 100 theoretical horsepower, irrigation of 10 acres, and domestic purposes in Multnomah County, at a cost of $1,000.

Thomas Marshall of St. Paul, Minnesota, covering the appropriation of water from two unnamed streams for irrigation of 21 acres in Hood River County, Oregon, at a cost of $200.

C. E. Shurlock of Lakeview, covering the construction of a reservoir for storage of 100 acre feet of water from Crane Creek, and the appropriation of the stored water for irrigation of 100 acres in Lake County, at an estimated cost of $1,000.

J. L. Dillon of Medical Springs, covering the appropriation of water from Dillon Spring for manufacturing and domestic purposes in Union County, at a cost of $1,500.

Tillamook City Water Commission of Tillamook, covering the appropriation of water from North Fork of Wilson River for a municipal water supply for city of Tillamook, at a cost of $150,000.

George Chamberlain of Mosier, covering the appropriation of water from Mosier Creek for irrigation of 7.46 acres in Wasco County, at a cost of $1,200.

M. V. Knight of Joseph, covering the appropriation of water from an unnamed spring creek for irrigation of 55 acres and domestic purposes in Wallowa County, at a cost of $1,000.

Medford Irrigation District of Medford, covering the construction of the Pinnacle Reservoir for storage of 7,500 acre feet of water from South Fork of Little Butte Creek for irrigation purposes in Jackson County, at a cost of $90,000.

New Incorporations

The following new water companies have been incorporated in California during the last month for which official records are available:

No. 115343—MANAKEE MUTUAL WATER CO., (a California company). Directors: J. T. LaBree, Lower Lake; Dr. R. A. Huntington, Lower Lake; Henry Lange, Lower Lake; Henry Grimshaw, Pasadena; E. R. Mullen, Pasadena, (each 1 share). Date of filing, August 18, 1925. Place of business, Lower Lake. Capital stock, $2,000. Par value, $10. Amount subscribed, $50. Purposes—to develop water in Lake County and to distribute it among stockholders at cost who have land reached by pipe lines of this company. Articles filed by E. P. Peers, 1130 Bank of Italy Building, Los Angeles.

No. 115369—RAVENSWOOD CO-OPERATIVE WATER CO. (a California company). Directors: J. H. Stubbe, Pearl R. Stubbe, Loretta M. Self, B. L. Harrison, Geo. Kayes, all of Ravenswood School District, San Mateo Co, Calif. Date of filing, August 20, 1925. Place of business, Ravenswood School District, San Mateo Co. Capital stock, none. Purposes—To furnish water to and irrigate 25.56 acres of land in San Mateo Co., known as Ravenswood School District. Water to be supplied only to owners of this land. Articles filed by Roy R. Waterbury, 418 Hobart Building, San Francisco.

No. 115542—LOMPICO CO-OPERATIVE WATER ASSN., (a California company). Directors: Lloyd Douglas, Menlo Park; Arthur Annis, 833 Market St., San Francisco; E. R. Ellis, 1027 Emerson St., Palo Alto; T. W. von Hacht, 898 Boyce Ave., Palo Alto; G. G. McDaniel, Olympia, Santa Clara Co. Date of filing, Sept. 2, 1925. Place of business, Palo Alto. No capital stock. Membership fee, $20. Purposes—To serve water for domestic and family purposes in Lompico Tracts of land in Santa Cruz County at cost to members of this company. Members are to pay $20 assessment for each lot supplied with water. Articles filed by Norman E. Malcolm, First National Bank Building, Palo Alto.

No. 115641—LAGUNA MUTUAL WATER CO. (a California company). Directors: J. A. Nelson, V. A. Johannsen, Louis Quinby, Wm. M. Smith, May Kennedy, all of Hemet, (each one share). Date of filing, Sept. 12, 1925. Place of business, Hemet, Riverside Co. Capital stock, $10,000. Par value, $20. Amount subscribed, $100. Purposes—to supply water, to its stockholders only, at cost on the following described lands. Lands of Hemet Land Co., according to map of said lands recorded in Book 1 of Maps at page 14, thereof Records of Riverside County, Cal., for domestic and irrigation use. Articles filed by Oliver P. Ensley, Atty, Hemet.

No. 115701—SUNNY SLOPE MUTUAL WATER CO., (a California company). Directors: Geo. H. Ennis, Los Angeles; E. L. Williamson, Riverside; R. C. Gill, Riverside, (each 1 share). Date of filing, Sept. 16, 1925. Place of business, West Riverside. Capital stock, $25,000. Par value, $5. Amount subscribed, $15. Purposes—to furnish and distribute water at cost of stockholders only for domestic and irrigation use, in proportion to number of shares of stock owned by stockholders. Articles filed by Leonard, Surr & Hellyer, Syndicate Building, San Bernardino.

No. 115730—SUNSET MUTUAL WATER CO., (a California company). Directors: C. M. Crawford, C. F. Mohler, C. W. Getchell, all of Los Angeles, (each 1 share). Date of filing, Sept. 18, 1925. Place of business, Los Angeles. Capital stock $10,000. Par value, $2.50. Amount subscribed, $7.50. Purposes—to furnish water to its stockholders within the area of Los Angeles city, described as lots 431 and 442 in Tract 606, recorded in book 15, pages 142 and 143 of Maps of Los Angeles County. Articles filed by Jas. L. Patten, 647 South Spring street, Los Angeles.

Upper Basin States Give Statement of Position

(*Continued from Page 18*)

control works would not be constructed unless the waters controlled are also appropriated and utilized for profit in the production of power and for other purposes. To make claim to waters of the river under such appropriations without first protecting the upper states by an equitable division of the waters as provided in the compact, would menace future development in those states. This must not be. We can not and will not co-operate with the lower basin states until protection is afforded our states by compact between the states interested. To that end, the representatives of our states stand ready to meet the representatives of the lower basin states, together with those of the federal government, to discuss and effect plans whereby flood control and full development of the river may proceed. Therefore, pending and until the approval of the Colorado river compact, considerations of self-preservation compel us to oppose the construction of any works for flood control, power development, or any other uses and we call upon the senators and representatives in Congress of the states of Colorado, Nevada, New Mexico, Utah and Wyoming and the public officials of said states, to use every legitimate means to protect the rights of our states as set forth herein.

"We commend and endorse efforts now in progress to bring about co-operative action by citizens to organize for the common purpose of protecting present and future development in the upper states.

"We earnestly ask the attention of the sub-committee of the committee on irrigation and reclamation of arid lands of the senate of the United States, authorized to proceed during the month of October to make a close and intimate study of the problems of the Colorado river basin, to the point of view of the upper states, as set forth in this address."

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AMONG OUR CONTRIBUTORS

Editorial Jottings About Current and Forthcoming Feature Articles, Dealing With Practical Problems of Hydraulics, and the Men Who Have Written Them

MARVIN B. ROUNDS, who has written for this issue an interesting article on irrigation practice in orcharding, became a part of the agricultural extension service only a year ago; but within that short period he has advanced to a unique position—at the head of the extension work for the biggest county, in point of agricultural produce in the United States. He is acting Farm Advisor for Los Angeles County, California.

Agricultural work in Southern California for the past 15 years, mainly with citrus problems, has given Mr. Rounds a thorough training in every aspect of citriculture. He has served as the manager of large ranches, and has been connected with the horticultural department of the county. He was identified for some time with the Bureau of Entomology under R. S. Woglum, who did eminent work in that department and who is now entomologist for the California Fruit Growers' Exchange. For six years Mr. Rounds was manager of the Azusa Foothills Citrus Company's large properties. Irrigation is one of his pet hobbies, and his understanding of soil moisture problems is one of the explanations for his splendid success in horticulture.

WATER USE was the subject of the paper delivered by H. M. Chadwick, Assistant State Engineer of Oregon, before the Oregon Irrigation Congress early in October, and the article under Mr. Chadwick's signature in this issue consists of a few excerpts from that address. Mr. Chadwick is an associate member of the American Society of Civil Engineers, the greater part of whose experience has been in connection with irrigation. He has been connected with irrigation development in New Mexico, Colorado, Wyoming and Montana, in addition to his extensive experience in Oregon. He was employed in Western Colorado as resident engineer on the construction of a mountain canal containing three tunnels and much open channel rock and earth work. This was in the latter part of 1909 and 1910, and was the job which thoroughly initiated him into the irrigation construction game.

Varied experience in locating water rights and making preliminary surveys for projects was gained in the neighborhood of Pueblo, Colorado, following which Mr. Chadwick was connected with the development of the Valier project, in Montana, for several years, serving as assistant chief engineer of operation and maintenance, in responsible charge of all engineering operations. In 1920, he went to Oregon as chief engineer for the Rogue River Valley Canal Company, in charge of the design and construction of the Medford Irrigation District. In 1923 he became assistant state engineer of Oregon, in which position his duties consist of the inspection and supervision of various irrigation construction works coming under the jurisdiction of the state office.

RALPH L. PARSHALL, who describes the improved venturi flume in this number, is senior irrigation engineer of the United States Department of Agriculture, Bureau of Public Roads, Division of Agricultural Engineering at Fort Collins, Colorado. The paper which is reproduced was printed in the Proceedings of the American Society of Civil Engineers, of which Mr. Parshall is an affiliate. Mr. Parshall is one of the workers of the Department of Agriculture who is doing signal service in the advance of the technical side of irrigation, and MODERN IRRIGATION is hoping to have the opportunity to present more articles from his pen in the future.

H. M. CHADWICK
Assistant State Engineer of Oregon

ROBERT A. THOMPSON, consulting engineer, who wrote the article on tht Garza Dam, was born and educated in Texas. He holds bachelor's and master's degrees from the University of Texas, and is a member of the American Society of Civil Engineers. He began his professional career with the Texas Geological Survey; was an instructor at the state university in 1893-94, and with the Texas Railroad Commission in 1895. Between 1895 and 1898, he served as engineer for several important construction projects, and in the latter year became chief engineer for the Railroad Commission of Texas, where he served for ten years. Subsequently he was chief engineer of the Railroad Commission of California, 1911-1913; and from 1913 to 1921 was a member of the engineering board of the Bureau of Valuation of the Interstate Commerce Commission. His record includes outstanding service, also, in the direction of various municipal construction projects. He is a member of the firm of water reservoir engineers of Nagle & Thompson, Dallas, appointed in 1923 to make a report on problems of additional water supply for that city, and in 1924 was placed in charge of the construction of the Garza Dam, which is to provide the needed additional supplies. He recently organized the firm of Thompson & Butler, consulting engineers, in which he is associated with H. G. Butler, former engineer of the California Railroad Commission, and power administrator in California. The office of the new firm is at San Francisco.

IN A RECENT issue we announced that a series of papers dealing with the activities of the Division of Water Rights of the California Department of Public Works was being prepared under the supervision of Edward Hyatt, Jr., chief of the division for publication in MODERN IRRIGATION. The first of these papers will be ready for publication in an early issue. Its subject will be "Water Titles in California", and it will deal with this important subject from such an angle that it will be of interest not merely to the irrigator in California, but to everyone who must deal with titles to water rights.

Another most valuable paper, prepared by an expert, will be ready for an early issue. This is being written by Thomas H. Means, consulting engineer of San Francisco, who some time ago consented to submit an article for readers of MODERN IRRIGATION. "I am working," writes Mr. Means, "on material for an article on a review of the irrigation development which has taken place over the world since the Great War. Some of the largest and most important works ever undertaken have been finished since 1918."

NOVEMBER MODERN IRRIGATION will be a magazine full of helpful material for the irrigationist and the water developer. "Credit for Irrigation Projects—How to Establish and Maintain It" is the title of an article which will appear next month, dealing in a practical and constructive way with some of the financial problems met by irrigation projects. "Permissible Canal Velocities," by Samuel Fortier and Fred Seobey, men whose names are significant in irrigation engineering circles, will be a technical discussion of an important subject to the hydraulic engineer. There will be half a dozen other features, just as interesting.

ONE OF THE interesting irrigation developments going forward in California is the construction of the irrigation system at Vista, San Diego County. Kenneth Q. Volk, the engineer in charge of the construction of this system, is writing a full description of the work for MODERN IRRIGATION.

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For 12 Months: $2.00, Single Copies: 20 cents.

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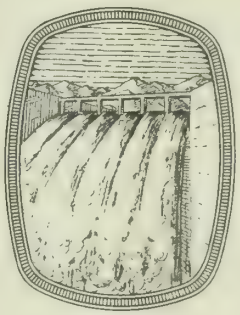
PETROLEUM WORLD 626 S. SPRING ST., LOS ANGELES, CALIF. MODERN IRRIGATION

ARTHUR P. DAVIS

International authority on hydraulics, who, at the recent Senate Committee hearings on the Colorado River question, which he attended by special invitation of the senators, held the background as perhaps the foremost technical advisor upon the engineering features of the problem. Through long experience in hydro-engineering affairs, including ten years as director of the Reclamation Service and first-hand contacts with reclamation enterprises in many parts of the world, he assumes a place of prominence in any irrigation gathering at which he appears.

MODERN Irrigation
The Magazine of Applied Hydraulics



Volume 1 NOVEMBER, 1925 Number 5

The Progress *of* Irrigation

WHETHER the problem of the Colorado River is nearer solution as the result of developments during October no one knows. Members of the senate committee—a sub-committee of the Committee on Irrigation and Reclamation —that met late in the month at Los Angeles, and continued their hearings in Southern California, Arizona and Nevada into the early part of November, have at least acquired a great deal of information about the various aspects of the different schemes proposed for the development of the river, and will go into the new Congress in December able to make intelligent recommendations. Public interest has undoubtedly been stirred to a greater extent than ever before, also, as the result of those hearings; and the publicity given them can hardly help being of influence toward an early settlement, of some kind, of the question which almost every one agrees is pressing for a conclusion most imperatively.

The unfortunate thing, however, is the fact that many people suspect that members of a senatorial committee do not always recommend action in strictest accordance with their investigations and findings, but have the habit of continuing to hold to the notions which were theirs prior to the investigations, based on their pet political philosophies or their particular personal connections.

AND EVEN when the committee has made its report, the Congress will not necessarily enact legislation which it recommends. Only a small proportion of the senate membership have seen for themselves what the Colorado is, and have heard from many sources what it means to the southwest. It is quite conceivable that others may let the eastern prejudice against further reclamation development, and a lack of interest in the whole subject, defeat whatever action may be championed by the committee.

There is, therefore, small ground for an optimistic belief that the Colorado question has been finally answered or that it is on the point of settlement. Those who are interested in seeing it answered must continue to work unremittingly to that end. Congress naturally will be hesitant about making an arbitrary decision in the matter when there is no apparent agreement between those most directly concerned. The several states whose inter-

ests are involved must find some common ground on which they can agree.

ADDITIONAL emphasis is given to this assertion by the decision of the Federal Power Commission, announced late in the month, to suspend action on all applications for power permits contemplating developments on the Colorado and its tributaries, "for a reasonable time," and urging that the interested states reach an agreement which will make possible such development in the future without the danger of interference on interstate grounds.

The special issue before the Commission when it announced this policy was the Girand application, seeking a permit for the construction of works for power development at Diamond Creek, but by the policy enunciated by the Commission, *all* pending applications are laid aside for an indefinite period—"a reasonable time," in the phraseology of the decision.

The Girand decision, on the face of it, brings the Colorado question to a focus. Too many years have been permitted to elapse in fruitless buckering between the states, and notice has now been served that if the states can not soon get their minds into substantial agreement on some policy that will afford protection to all interests, the Federal Power Commission will be obliged to say: "There seems no chance of a concerted and constructive policy; let the development so urgently needed begin under private and corporate auspices. Better a policy that will not suit everyone than no policy at all."

THE REPORT of E. C. La Rue on the Colorado River, issued during October by the U. S. Geological Survey, received a warm, if not cordial, reception. Mr. La Rue has spent fifteen years getting acquainted with the river, and should know something about it; but his report and the plan which he has advanced for the development of the resources of the river have already become the target of a merciless attack of criticism from many sources. One of the chief critics has been William Mulholland, chief engineer of the Los Angeles Water Department, who, reinforced by his chief assistant, H. A. Van Norman, attacked the "La Rue plan" without reserve before the senate committee. Mr. La Rue, in turn, has objected to Mr. Mulholland's attitude on the ground that the Los Angeles engineer is not familiar with the problems of the Colorado, nor qualified to criticize a report prepared by one who has spent a decade and a half in its study.

Mr. La Rue's report presents an ambitious scheme for the development of the river below the mouth of Green River, with particular reference to flood control and the development of power. An adequate plan for the development of the river, in his opinion, would involve the construction of thirteen dams at various points on the river, and he proposes a gravity system for bringing water to Southern California for domestic use. His critics regard the plan as visionary and impractical from both an engineering and a financial standpoint.

IRRIGATION'S progress is not alone achieved by the building of dams, the laying of pipes and the growing of crops. It proceeds on all fronts simultaneously, and its advance in one sector must be met by similar victories in the others. In the courts of the land, and the various tribunals created for the consideration of its problems, it must fight its battles—battles which are as important, perhaps, as any that are fought out in legislatures, or before boards of directors, or by engineering staffs.

A case of great importance to irrigation is now pending before the Supreme Court of California which may be considered, perhaps, one of the critical skirmishes in the march of irrigation. The cause at issue is that of Herminghaus *vs.* the Southern California Edison Company, a piece of litigation which involves the whole broad foundation of the theory of riparian rights.

In the decision of the trial court, from which an appeal has been taken—now pending before the Supreme Court—it was found that the riparian owner of lands could prevent the storage of winter flood water either by appropriators or riparian owners if such storage interfered with any use of the water by the lower riparian owners. By this conclusion the plaintiff, Mrs. Herminghaus, was held to be within her rights in attempting to prevent the Southern California Edison Company from impounding waters of the San Joaquin River on the ground that the river customarily overflows its banks in the winter time, producing pasturage and enriching the lands of the riparian owners by the deposit of sediment.

The Irrigation Districts Association has considered this pending litigation of enough importance to instruct its attorneys to file a brief in the case and to appear at the hearing of the appeal as *amici curiae*.

Those interested in the broader aspects of irrigation will look forward with real interest to the outcome. The contention of the defendants and of the irrigation interests is that the time has come for the old conception of riparian rights to undergo some modifications; a theory of reasonable use seems called for. The traditional law on the subject grew up under circumstances vastly different, and is based upon considerations far removed, from those which should control water development under present conditions.

Members of the Senate committee conducting hearings on Colorado River problems as they appeared in their session in Los Angeles. From left to right: Senators Hiram W. Johnson, Samuel M. Shortridge, California; Tasker L. Oddie, Nevada; Lawrence C. Phipps, Colorado; Charles L. McNary (chairman), Oregon; John B. Kendrick, Wyoming; Key Pittman, Nevada; C. C. Dill, Washington, and Henry F. Ashurst, Arizona.

Members of Senate Committee on Irrigation Hear Pros and Cons of Colorado Problem

By DOUGLAS G. McPHEE

CITIZENS of the southwest, during October, had impressed upon their collective consciousness the fact that around the fundamental question of water revolves the whole future of the great southwestern empire. Irrigation held the spotlight of attention in the forum and the press. Members of the United States Senate Committee on Reclamation and Irrigation, headed by its chairman, Senator Charles L. McNary, of Oregon, meeting at Los Angeles, summoned before them a succession of witnesses who presented probably the most comprehensive discussion of various aspects of the problem of the development of the Colorado River ever given before such a tribunal.

The two days' hearings in Los Angeles on October 26 and 27 served as the beginning of an intensive study which the Senate committee will not conclude until November 12, when it visits the site of the proposed Boulder Dam on the Colorado River. Hearings in San Diego, a visit to many of the cities of the Imperial Valley, an inspection of various points involved in proposed plans of developing the river, an inspection of the Yuma project, and sessions in several cities of Arizona were included in the committee's itinerary.

The hearings in Los Angeles were notable gatherings in the name of irrigation and hydro-electric development, not only because of the senators who surrounded the long table, but because of the character of many of the witnesses and the assemblage that "listened in" on the testimony. The list of witnesses included the names of many eminent irrigationists, both technical men whose testimony bristled with concrete engineering data, and non-technical men, whose interest in the river problem was expressed in terms of the constantly growing section of the country so largely dependent on this resource.

Another type of man was well represented also—the politician—men whose concern in the Colorado River question is predicated upon the reaction of their constituents to their expressed attitude. They were there in force, each with an ear to the ground and the other cocked acutely in the direction of the amplifier from which the testimony of witnesses was reproduced in stentorian tones.

HOLDING the center of interest, of course, was the senatorial committee. At one end sat Hiram Johnson, California's senior senator, polished of diction, aristocratic of appearance, softly modulated of voice. It was Johnson the advocate, rather than Johnson the judge, however, for he is the legislative father, in the Senate, of the Swing-Johnson bill, to which most of the time was devoted in the Los Angeles sessions. It was Johnson who "programmed" the speakers in behalf of the measure, especially of its characteristic feature, the All-American Canal; it was Johnson whose gentle voice elicited for the record the qualifying facts to establish the authority of the witness; it was Johnson who frequently brought out, with a few pointed questions at the end of the testimony, an essential fact or two that the witness had neglected.

Next to him sat Samuel Shortridge, his colleague in the senate, but not always his supporter in issues of legislation. Shortridge is an orator by instinct and profession, but during the hearings his oratory was repressed. A long bony fore-finger, shaken in the direction of the witness or a map or a diagram, constituted the major part of his contribution to the sessions as he requested that this point on the map be identified or that point in testimony be more clearly explained. Shortridge is one of the senators who was closely watched during the hearings, for until the present time he has not made his position on the Swing-Johnson bill particularly clear, while his rivals in the forthcoming senatorial race are raising the issue against him. Both factions are listening intently for a definite statement of his position on the measure.

Senator Tasker L. Oddie, of Nevada, sat on Senator Shortridge's left. He was flanked, on the other side, by Lawrence C. Phipps, of Colorado. Neither of these said much—perhaps they thought a great deal. The rotund countenance of Senator Oddie and the florid one of Senator Phipps expressed little except ennui during most of the hearing. The latter consumed an infinite number of cigars.

IN THE CENTRAL location at the table was Senator McNary, of Oregon, chairman of the committee. Senator McNary takes his position seriously. He was always in his seat, always following the testimony closely. He looked tired, and doubtless was tired. His position as chairman was not an enviable one, for it was a continual struggle against time and against verbose witnesses who felt that their particular messages were important enough to warrant taking just a few minutes over their alloted periods.

John B. Kendrick, of Wyoming, was on McNary's left, and next to him sat Key Pittman of Nevada. Neither spoke

often, but Pittman, when he spoke, committed himself clearly to the belief that the Swing-Johnson bill in its entirety is extremely doubtful of passage, and that the thing which could be done and ought to be done is to submit a bill for flood protection only to the next congress. "Such a measure would be passed by the Congress," he declared, "and it would then be for the government to decide what kind of a dam should be erected in order to return the expense of construction." There was some applause for this declaration, but it was discounted by others who have counted Pittman as the foe of the essential idea behind the Swing-Johnson bill.

Senator C. C. Dill, of Washington, and the suave Henry F. Ashurst, of Arizona, completed the committee at the Los Angeles sessions. Senator Ashurst sat on the other side of the table from Senator Johnson and it was apparent that he was on the other side of the question under discussion, as well. Senator Ashurst spoke occasionally, at one time rising to ask permission of the chair to introduce three representatives of his state for testimony. He thanked every one at the table; he thanked the chairman for the time, the committee for listening, the witnesses for appearing. It was a beautiful example of "senatorial courtesy."

AROUND the outskirts of the senate committee was a fringe of other notables. Congressman Phil D. Swing was much in evidence, sitting close to Senator Johnson and often conferring with him. Swing is the father of the Swing-Johnson bill in the House of Representatives.

Another congressman, John D. Fredericks, spent some time around the hearings. He was the author of the Fredericks bill, introduced before the last Congress as a substitute measure for the Swing-Johnson measure and favored by some interests in opposition to the latter.

Joe Crail, candidate for Congress to succeed Fredericks, was also in attendance at the hearings. Mayor John L. Bacon of San Diego, Mayor George E. Cryer of Los Angeles, William Gibbs McAdoo, himself both an engineer and a politician of no mean parts; Robert M. Clarke, champion of the Swing-Johnson bill and candidate for the senate to succeed Shortridge—all these were present and accounted for.

Irrigation had its representatives there, also, as well as politics. Behind the senatorial table sat Arthur P. Davis, former director of the national Reclamation Service, and now chief engineer and general manager of the East Bay Municipal Utility District of Oakland, California. He was there in quasi-official capacity, called at the request of the senators as an acknowledged authority to give testimony on technical questions when needed. With him was F. E. Weymouth, also formerly of the Reclamation Service.

Scattered about the room among the audience were other notable irrigation figures. Professor Frank Adams, of the University of California, was there with a number of his colleagues from the Department of Agriculture. Several of Los Angeles' eminent irrigation engineers dropped in for an hour or two during the hearings. "Big Bill" Mulholland, chief engineer of the Los Angeles Water Department, and his chief assistant, H. A. Van Norman, were there, and later testified before the committee, as did F. A. Reid, president of the Salt River Valley Water Users' Association, and several officials of the Imperial Irrigation District.

The Swing-Johnson bill, and especially the All-American Canal, received most of the attention of the committee in Los Angeles, the proponents of the measure having an opportunity, because this is the measure concretely before Congress, to make the most exhaustive showing in favor of the bill that has ever been afforded. When the Los Angeles hearings were over, and the committee on its way south, where the river was to be studied in its own habitat, there was no official statement given out, but it was apparent that there was a strong division of sentiment among the members. Senator McNary was believed to be favorable to a recommendation of the Swing-Johnson bill to Congress, and was quoted by the press as saying: "In my opinion a favorable report will be made to Congress in regard to the Colorado River dam. . . . Swing and Johnson have proposed certain legislation . . . the committee will probably adopt some of the proposals." Such a qualified statement, of course, means approximately nothing.

Federal Power Commission Suspends Action on Colorado River Permits

ACTION on all applications for power licenses on the Colorado River and its tributaries now pending before this commission, and not finally acted upon, including the Girand application, is hereby suspended for a reasonable time.

"Constructive governmental policy requires that the states affected should, and they are hereby urged to reach, as speedily as possible, an agreement among themselves for the division of the waters of the river system, all to the end that thereupon developments may proceed unchallenged upon interstate grounds."

Such was the important and far-reaching decision of the Federal Power Commission, late in October, after consideration had been given to the application of J. B. Girand, former state engineer of Arizona, and associates, who sought a permit to develop power at the Diamond Creek site on the Colorado River in Arizona.

The Commission's decision not only suspends action on the Girand application, but holds up more than a dozen other applications for power permits contemplating developments at various points on the Colorado River. It does more than this, however, for it enunciates a policy to be followed in the future "for a reasonable time"—a policy that urges that an agreement should be reached by the Colorado River States before a program of development is authorized.

The decision on the Girand application followed a hearing at which several state governors and members of congress representing the seven states interested in the Colorado River question were heard by the Federal Power Commission, most of them opposing the application and asking for a postponement of action. The basis of the opposition was that any reservoir erected at present in the river system might affect the water rights of each of the states, although the states involved have not yet been able to reach a mutually satisfactory conclusion in the negotiations among themselves for the settlement of their respective rights.

A variant interpretation has been put upon the phrase "a reasonable time" upon which the Commission has apparently laid stress in reaching the decision quoted. Some observers believe that the Commission emphasizes that it is witholding action for a reasonable time only as an indication that it will be obliged, should the *impasse* between the states continue without indication of a settlement being possible, to consider the various applications now pending before it, each on its own merits, and to grant such applications after the "reasonable time" has elapsed.

Other observers see in the phrase an indication that the Commission is expecting some definite and constructive action to be taken by the forthcoming congress that will provide a basis for the future development of the river and its tributaries.

This Project Involves Some Interesting Problems in Irrigation Construction

A Conduit Was Built Over Twelve Miles of Rough and Rugged Country, and a Flume "Shot From Guns"

By KENNETH Q. VOLK
Chief Engineer, Vista Irrigation District

THE VISTA Irrigation District embraces 17,500 acres of beautiful rolling lands in Northern San Diego County, located midway between the towns of Oceanside and Escondido and about 100 miles south of Los Angeles.

The water supply for the district is derived from Lake Henshaw, having a storage capacity of 164,000 acre feet and a drainage area of 210 square miles of high mountain area. Lake Henshaw is the property of the San Diego County Water Company, from which company the district purchases its water supply. The water from the Henshaw Reservoir is allowed to flow down the San Luis Rey River to the intake of the Escondido Mutual Water Company's canal, from which point it is transported through that company's concrete lined canal to Lake Wohlford. The delivery point for the district's water is at the tail race of the power house to be constructed by the San Diego County Water Company below Lake Wohlford and five miles north of the town of Escondido. From this point the water is transported through a conduit constructed by the Vista Irrigation District.

This conduit has a total length of 12.8 miles and a capacity of 44 second feet and is constructed through a rough and rugged side hill country. The conduit consists of 2,000 feet of tunnels, 7,300 feet of 42 inch gravity concrete pipe and 4,600 feet of 42 inch reinforced concrete pipe, 19,000 feet of 36 inch and 40 inch riveted steel siphons, and 35,000 feet of Gunite bench flume.

ONE of the most interesting parts of this project from an engineering standpoint is the construction of the "Gunite" bench flume. The dimensions of the flume are 3 feet and 4 inches in depth by 4 feet, 3 inches in width. The side walls are only 2 inches in thickness and the bottom 2½ inches. Reinforcing of the side walls consists of 4x4 No. 6 x No. 6 electrically welded galvanized mesh. The side walls are reinforced by bending the mesh through ½ inch square bars and the bottom of the conduit is reinforced by 5 x 9 x No. 12 x No. 12 electrically welded galvanized wire. The top rails of the flume are held together by a precast concrete bar 2 inches square containing a ¾ inch steel rod placed at eight-foot intervals along the flume.

Laying a 42-inch reinforced concrete siphon over a precipitous incline.

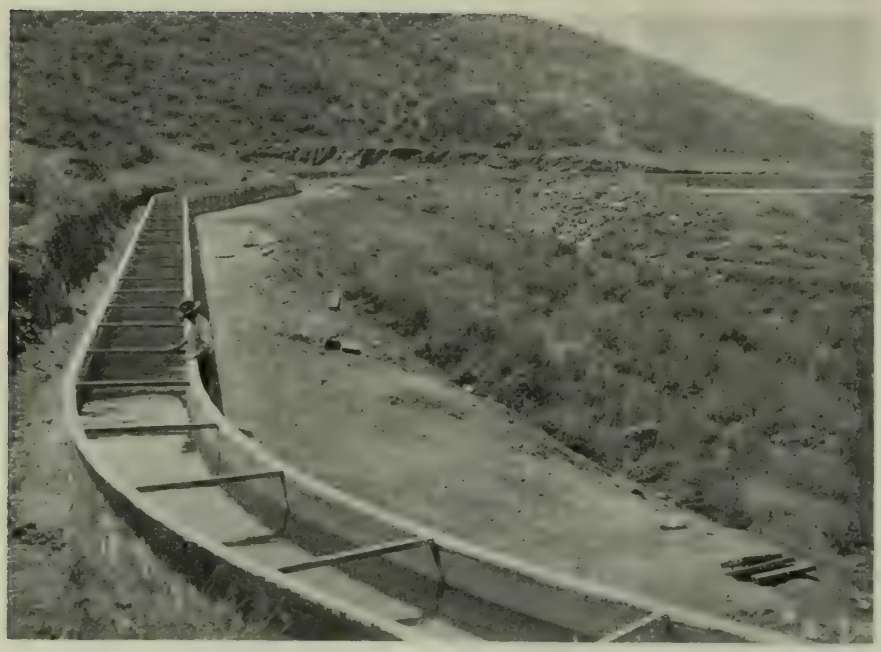
This type of construction was adopted after a careful study as being peculiarly fitted to the steep and rocky character of the side hills on which the flume was to be built. The method of construction consists of the excavation of a roadway to proper grade, width and location, on which the "Gunite" bench flume is constructed. After the roadway is roughly graded, the materials for constructing the flume are hauled by truck and deposited on the outside of the roadway. After all materials have been hauled, the subgrade is thoroughly wet and tamped to avoid settling.

Next, the forms for constructing the flume are set to proper alignment and grade by crews of form setters. Light wooden forms were used for constructing the flume so that curves could be readily made by bending the forms rather than having special curves for all bends. Standard curves of 50, 100 and 200 foot radius were used on the location of the conduit. These light forms allowed the carpenters to set them continuously regardless of the radius of curvature.

MESH for reinforcing the bottom was laid on the finished subgrade and the forms set thereon, after which the reinforcing crews placed the reinforcement for the side walls and rail, rigidly securing them in position. The placing of the reinforcing requires considerable care as the thickness of the walls is only 2 inches.

The compressors used in connection with the Gunite work were 6 x 8 pneumatic compressors mounted on caterpillar tractors. The guns used were N2 Guns made by the Cement Gun Company, Inc. The materials used in constructing the flume consisted of one part of cement to four and one-half parts of coarse sand. All sand for the construction of the flume was hauled from Escondido Creek and screened just prior to its use. Measured quantities of sand and cement were mixed in a small concrete mixer and them dumped on to a platform and shoveled into the gun. Seldom was more than 100 feet of material hose used in shooting the flume.

The side walls and fillets at the junction of the floor and side walls, together with part of the rail, were shot first. After approximately a fifteen minute interval, the balance of the rail was completed by shooting on an additional layer. Shooting the bottom of the flume was carried on in such a manner that seldom was there more than 100 feet of side walls constructed ahead of the floor. The light wooden forms were



When the bench flume was done. The completed flume, carrying water. Notice the many curves made necessary by the irregular topography.

first held in place above the floor by resting on temporary bracing which was removed as the floor was constructed. Approximately 1,000 feet of forms were needed with each Gunite crew. The forms were generally stripped 48 hours after construction of the flume. Frequently, however, forms were stripped within 24 hours and the flume filled with water so as to receive its maximum stress within this period of time.

CONSTRUCTION work on the bench flume was started at points where water could be secured for construction and for curing of the flume. Small wooden dams were placed in the flume approximately at the end of each day's run and water pumped in until the dams were filled.

The advantages of this type of structure are:

1. Economy of construction is effected, particularly in a rugged and rocky country.
2. Side hill drainage water is eliminated, which is extremely advantageous where water is used for domestic purposes.
3. It is difficult for animals to get into flume.
4. Fencing is not required.
5. Smaller sections can be used on account of smooth interior finish left by shooting against the form.

The flume is constructed as a monolithic structure and has no expansion joints. Two gunite crews were employed on this work, each crew consisting of approximately 28 men. The daily progress varied from 150 to 200 linear feet.

The main conduit terminates at the distribution reservoir having approximately 250 acre-feet capacity. Several laterals are taken off the main conduit before it reaches this point. However, the greater portion of the district's water passes through this reservoir.

The distribution system is constructed entirely of steel and concrete pipe; the concrete pipe ranging from 8 to 36 inches in diameter, and the riveted steel pipe from 4 to 18 inches in diameter. All pipe lines were laid with sufficient cover to allow for cultivation of the soil. All steel pipe is double dipped and wrapped with a protective coating to prolong the life of the pipe. The concrete pipe used in the distribution system is constructed under a very rigid specification. Both steel and concrete pipe lines are guaranteed against leakage and breaks for a period of one year after installation.

OWING to the rolling nature of the lands in the District, numerous steel siphons are necessary for transporting the water from one ridge to another. The main distribution line of the district follows along the foothills at a high elevation, the main laterals taking off the same at proper intervals and carrying the water to various points of the district. Six circular concrete regulating reservoirs are provided for controlling the flow to various laterals. The system has been designed so as to provide for both irrigation and domestic water.

Primary distribution to units of 40 acres has been provided in the initial construction. Since the territory served by this system is destined to be subdivided into small acreages and intensively developed, due to the favorable climatic conditions, further extensions of water delivery will be made progressively as development and settlement demand.

The design and construction of the entire system has been supervised by J. B. Lippincott, Consulting Engineer for the district.

Splendid progress has been made on the construction work of the Gunite bench flume and on the distribution system. It is anticipated at this time that water will be turned into the line by February 1st, 1926. The rapid progress of construction can be attributed to the splendid support received from the Board of Directors and the people of the district.

How the bench flume was shot from guns. The cement gun "shooting on" the walls of the flume. Note the 4x4 electrically welded mesh reinforcing of the sides.

A DESOLATE OUTLOOK
These lands, once cultivated, have been rendered unproductive by alkali accumulation.

Protecting Our Irrigated Lands From Seepage and Alkali

By D. W. MURPHY
Consulting Engineer

ONE of the problems which must be recognized and cared for, in practically every irrigated area, is that of protecting the soils from becoming water logged and alkaline. It is a common experience that irrigated soils deteriorate through alkali accumulations in them. The question may be asked, Why should soils, once fertile, and free from harmful quantities of injurious salts, become useless through their accumulations? The answer to this question lies in the fact that soils of arid and semi-arid regions are seldom if ever free from alkali.

In the formation of soils the rocks from which they are formed are disintegrated through the action of various natural agencies. Under arid conditions the mineral salts which are set free in the process of disintegration are not so completely leached out of the resultant soils as is the case in the humid areas. This is due to lack of rainfall to complete the leaching process. These mineral salts generally are beneficial and many of them are necessary to plant growth. Some of them, however, especially in excess quantities in the soil, will prevent the growth of practically all forms of useful plants.

IN THE PROCESS of soil formation the mineral salts are distributed, more or less uniformly, throughout the soil mass. In this condition the content of harmful salts generally is not large enough to render the soils unfit for cultivation or growing crops. When, however, they become concentrated in a particular locality, or, as is commonly the case in irrigated areas, in the surface layer of the soil, the content of harmful salts may become so great as to prevent plant growth.

The most common agency which causes concentration of alkali and other salts in the soil is water. Through the action of water, applied in irrigation, the salts which originally were more or less uniformly distributed in the soil may be brought to the surface.

The application of excess quantities of water and the lack of proper drainage are the principal causes of the rise of alkali in soils. The salts are dissolved by the water in the soil and carried upward in solution by capillary action. When the water is evaporated the salts are left on or near the surface. It may be assumed that a larger part at least, of the soils of the arid region contain sufficient harmful alkali salts to render them unfit for growing crops, should these salts be concentrated at the surface.

Conditions which are favorable to bringing up and depositing mineral salts are, first: free ground water at relatively shallow depth; and, second: free evaporation from the surface of the soil. The first of these may be brought about by excess application of water. The second is a provision of nature that wherever moist or wet soil is exposed to the action of sun and atmosphere, evaporation will occur. The rate of evaporation depends upon the temperature of the atmosphere and the amount of moisture which it contains. In the arid sections, especially the southwestern United States, high temperatures and dry atmospheres ordinarily prevail. The rate of evaporation consequently is high.

When free ground water rises near to the surface, the soils also become nonproductive, due to excess water in them. Useful plants, with but few exceptions, will not live with their roots in free water, nor in a soil the pore spaces of which are filled with water.

TO MAINTAIN the irrigability and productiveness of soils they must be protected from excess accumulations of ground water. In other words, the zone of saturation or free water table must be kept well below the surface of the soil. To give this protection requires, first: careful application of water in irrigation; and second: that soils have adequate drainage. Where nature has not provided underground drainage sufficient to carry away the excess water which finds its way into the soil, this should be provided by artificial means.

It is a difficult problem to determine the amount of water that should be applied in irrigation. This amount should be sufficient to insure the best results in growing crops, without, at the same time, doing injury to soils through the application of excess. There is involved, also, the question of how this water shall be applied in order to reduce underground waste to a minimum. It should be remembered that water which sinks below the zone of plant growth is lost so far as being of benefit to growing plants. It may also become a menace to soils by raising the water table to a dangerous height.

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W. L. POWERS

Newly elected secretary of the Oregon Reclamation Congress, and Secretary, since 1915, of the Oregon State Drainage Association

Oregon Maps Out Constructive Program of Development

Reclamation Interests are all United in Effort to Increase State's Agricultural Wealth and Double Area of Productive Lands

By W. L. POWERS

AT THE ANNUAL meeting of the Oregon Congress at Grant's Pass, October 5-7, the name of the Congress was changed to Oregon Reclamation Congress, and the scope of the work was broadened to the end that drainage districts and logged-off land districts also can be part of the organization. The Oregon State Drainage Association will meet at Salem about the first of December, at which time the Association will have an opportunity to affiliate with the Reclamation Congress.

The new constitution of the Reclamation Congress calls for five trustees from each congressional district, or fifteen trustees in all. The new President, Wilford Allen, of Grant's Pass, has been an active official in the old Oregon Irrigation Congress for several years. The new Secretary has served as Secretary of the State Drainage Association the past ten years; hence all reclamation interests are united in the new organization, the Oregon Reclamation Congress, which will have for its purpose the general good and advancement of reclamation throughout the State.

The Oregon Reclamation Congress is devoting its efforts to the development, as feasible, of the arid and wet lands of the State whereby the productive area of improved farm land in Oregon can be doubled, the balance of rural population maintained, the wealth producing and assessed valuation greatly enlarged, and the different regions of the State consolidated.

The Oregon Irrigation Congress has held fifteen regular annual sessions, with a steady gain in strength and accomplishments. It has been instrumental in educating the people as to the need and value of irrigation, and has secured a modern irrigation district law, under which some sixty-five projects have developed, embracing a million and a third acres, of which over one-third of a million acres have been actually reclaimed. During the period of 1909 to 1919 the irrigated acreage in Oregon increased 43.2 per cent. The acreage these enterprises were capable of irrigating increased 57.6 per cent. Just now the need is for closer settlement and improvement of land for which water has been provided.

GOVERNMENT reports show that the increase in irrigated land accounts for one one-third of 1% of the gain in improved farm land during the past decade, and, further, that the increase in population is more rapid than the increase in food production. Looking to the future, there is need of developing our arid soil and water resources by irrigation to the utmost. We should plan our reclamation programs for a decade ahead if we are to continue to be self-supporting and produce our own foodstuffs. Thirty-six hundred families would fill up all the partly developed irrigation projects in Oregon. The quality of the soil and the water supply in these projects has been passed on by State authorities, a plan of colonization is being developed, and good progress is being made in settling up several of these newer projects.

Three new Federal reclamation projects have been designated in Oregon and appropriations made therefor. In the past Oregon has paid into the Federal Reclamation Fund approximately $12,000,000 and has received back on Oregon projects about $6,000,000. In addition, there will be derived from the sale of government timber within Oregon approximately $300,000,000, 65 per cent of which will revert to the Federal Government. The terms of the new reclamation law will make the annual cost of land and water on these new Government projects very reasonable and should insure settlement.

The Oregon State Drainage Association was organized in the year 1915. It was aimed to combine the agencies interested in drainage, accumulate data, disseminate information, secure needed legislation, and by other legitimate means further development, as feasible, of the 3,000,000 acres of wet lands in the State. The association has held ten annual conferences and five summer field tours, and has enjoyed a steady growth. Four biennial reports have been published that form a record of accomplishments from the date of organization. Through the Association's efforts a modern drainage district law was secured and perfected. Some sixty districts have been organized, which have drained and improved a quarter million acres of now very productive land. The association has assisted in securing rural credit legislation and various measures looking to the welfare of settlers on reclamation projects.

The Oregon Reclamation Congress has important work ahead in connection with the development of the great fundamental soil and water resources of the State, and a comprehensive program of consistent development must be carried out as a matter of public policy.

RESOLUTIONS passed at the recent annual meeting provided:

"That it be urged and demanded that properly constituted authorities of the Federal Government go forward with projects in Oregon for which Congress has made appropriations;

"That the attention of the Eastern and Mid-Western communities, through their publications, be called to the fact that the Reclamation Fund is created by no draft or tax on them, but is constituted exclusively from the sale of public lands, and the revenues of oil leases from the eleven Western States, and is a Western fund;

"That it be made clear that settlers upon government projects must meet their obligations when it is known that they are able to pay the charges assessed against their land;

"That the legislature of the State provide for topographic mapping of those

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Electricity is the *Power Behind the Pump* in Modern Irrigation Developments

The Las Posas Valley is Undergoing a Great Transition Under the Influence of Water

By F. E. ANDERSON *

A STUDY *in contrast between the old and the new in water development in the Las Posas Valley.* UPPER LEFT—*A symbol of the vanished era. This windmill was installed in 1892.* RIGHT—*The switchboard at the main plant of Zone No. 1 Mutual Water Company, Somis, California.* LEFT—*Interior view of main pumping plant.*

NOTABLE transitions are taking place in Ventura County, in Southern California, both *in* irrigation and *because of* irrigation. Ventura County—especially the fertile Las Posas Valley, located in its southern half—has long been famous for its production of lima beans, growing what its boosters assert to be more and better and bigger beans than any other section of the world. Today, with increasing supplies of water, large districts in this county are being planted to orchard crops, which the richness of the soil and the ideal climatic conditions make even more profitable than the famous beans.

In irrigation itself, equally significant changes are evident. Occasionally, throughout the valley, the observer may see the windmills of a vanished era, whose puny efforts in days gone by brought a feeble flow of water out of the earth. Today the power behind irrigation is largely electricity—functioning through the most modern and complete motors and pumps, and controlled by complicated switchboards which the irrigators of a decade past could hardly have imagined—much less understood. Delicate electrical devices, the product of the new electrical age, are lending their assistance to the effort to join water and power in a partnership that will give an adequate supply of water to allow the maximum utilization of the wealth dormant in the soil.

POSSIBLY the greatest factor leading to these new developments in the Los Posas Valley has been the work of the Zone Water Companies. The organization of these companies dates back to 1919, when the stockholders of the Las Posas Water Company engaged an engineer to make the necessary studies to determine whether an irrigation system would be feasible.

The first well was drilled in the latter part of 1920, and it was followed successively by five additional wells, two of which have been recently completed. On these latest wells the pumps and motors are now being installed.

The source of water upon which the companies depend is the Las Posas Creek, located near Somis, in the same county. An area of approximately 172 acres is included in the source of the supply. The average depth of the wells in this water-bearing stratum is 650 feet, and the average draw-down 65 feet. The total flow of all wells at the present time is 850 M. I.; while it is expected that the ultimate development will amount to 1000 M. I.

ZONE "No. 1" covers the lower area of land, and Zone "No. 2" the higher levels. These two zones comprise an area of 4291 acres, which is served by 23 miles of concrete pipe of all sizes,

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* Mr. Anderson is sales engineer for the Westinghouse Electric and Manufacturing Company at Los Angeles.

The Design and Construction of Concrete-Lined Distributing Reservoirs

Some Interesting Data on Distribution Reservoirs in General and the Stanford Heights Structure in Particular

By I. E. FLAA

DISTRIBUTING reservoirs are used for receiving water from long conduits, leading from the source of supply into the cities which they serve, and there regulating the flow into the distributing system. This regulation of flow is necessary due to variation of consumption during a 24-hour period, the maximum consumption for a short period being greater than the carrying capacity of the conduit, and also to give a continuous supply to the district during the period of shut-down on the conduit due to accident or other causes.

Distributing reservoirs are also used for regulating the flow and pressure in pumping systems.

The capacity and location of distributing reservoirs depend upon the requirements of the district to be served. The type depends upon the physical character of the available sites.

Among the important types are the: (1) Excavation and rolled embankment in earth with the necessary impervious lining; (2) Concrete, steel and wood tanks; and (3) Standpipes.

IN A DISTRIBUTING system it is desirable to maintain a pressure between 40 and 50 pounds at the tap; thus it will be seen that in any city having a wide range of elevation, in order to maintain the pressure of 40 to 50 pounds, the area must be divided in zones between every 100-foot rise in elevation, thus requiring some regulating device for each zone or pressure district; while a flat city will require only one regulating reservoir or possibly two.

In San Francisco, with elevations varying from sea level to nearly 1000 feet above sea level, seven distributing reservoirs and fourteen tanks are rerequired at the present time properly to regulate the flow in the nineteen major pressure districts into which the city is divided.

The East Bay Cities of Oakland, Alameda, Berkeley, Hayward and Richmond, with towns and communities in between, served by the East Bay Water Company, with a variation in elevation from sea level to 1400 feet above sea level, require twenty-five reservoirs and seventeen tanks.

In Sacramento, which is flat, only one reservoir is used and that is in conjunction with the present filtration plant. In San Jose, another flat city, one reservoir.

EXCAVATION and rolled embankment reservoirs require a detailed study in every case, first because the location is limited to a predetermined elevation, there being only a relatively small number of available sites at the particular elevation required in the proximity of the district to be served, and a study must be made to determine which one lends itself to the most economic construction.

THE accompanying article is taken from a paper presented by the author to the California Section of the American Water Works Association, at its Sixth Annual Convention, at Santa Cruz, in October. Mr. Flaa is chief draughtsman for the Spring Valley Water Company, of San Francisco, and his paper dealt with construction work on three concrete-lined distributing reservoirs by that Company—the Stanford Heights reservoir, the Niles Reservoir, and the University Mound Reservoir, which was recently raised six feet above the limits of the old embankment originally built in 1880. The first of these construction jobs only is described in this excerpt from Mr. Flaa's paper.

In the past three years the Spring Valley Water Company has constructed two concrete-lined reservoirs, each having a storage capacity of five million gallons, and have increased the storage capacity of a third—the University Mound reservoir—from 41,000,000 to 59,000,000 gallons, a gain of 18,000,000 gallons storage, by raising the present embankment 6 feet and lining it with concrete. In the two 5,000,000 gallon reservoirs recently constructed, the general problems of design were similar but the method of construction and some of the details were different. One of these, the Stanford Heights reservoir, located in the western portion of the city at elevation 600, was constructed to meet the increased demand of the new residential district between elevations 400 and 500 feet in that region. It is located on a hillside having a slope of about 7 to 1, that is, seven horizontal to one vertical. A full city block 663 feet long and 228 feet wide was available at the particular elevation and location. An excavated and rolled embankment reservoir for 10,000,000 gallon storage was designed to cover the entire block, with a reinforced concrete division wall in the center dividing it into two equal parts.

FOR OUR present needs only one-half capacity or 5,000,000 gallon storage was required; so the westerly half was constructed in the spring of 1923. This portion is 300 feet by 155 feet on top, 215 feet by 88 feet on the bottom, and is 22 feet deep with inside side slopes of 1½ to 1 and outside embankment slope of 2 to 1, and crest of embankment 10 feet wide. It is lined with a 6-inch slab of reinforced concrete placed in 30-foot squares on the bottom and 20 feet by 40 feet sections on the sides. The lining has total of 5/10% temperature reinforcing, or 2½/10% in each direction, consisting of one-half inch square bars spaced 16 inches both ways; each section is separated from the adjoining section by expansion joints.

A tar and gravel roof is supported by 8 inches by 8 inches precast reinforced columns 24 feet long spaced 20 feet apart; these columns are reinforced with four one-half inch bars and were set in precast concrete footings grouted to the floor and side slabs. The roof beams are two 3 feet by 12 inch Oregon Pine, 20 feet long, rafters are 2 inches by 8 inches by 20 feet long, spaced 30 inches, on which is placed a 1 inch by 10 inch pine flooring covered with a paper tar and gravel covering. The excavation and rolled embankment was made as if the entire 10,000,000 gallon reservoir were to be finished, leaving the easterly end open. This end was closed by a reinforced concrete division wall designed and constructed to withstand the full head of water from either side, the other side being empty. This wall is 22 feet high, 10 inches thick on top and 15 inches thick on the bottom and is supported with 14 inches thick counterforts on both sides spaced about 9 feet apart.

The wall and counterforts rest upon a slab of concrete 20 feet, 3 inches wide and 22 inches thick. The outlet gate and screens are contained in a square concrete tower set in the division wall and made a part thereof. It is divided

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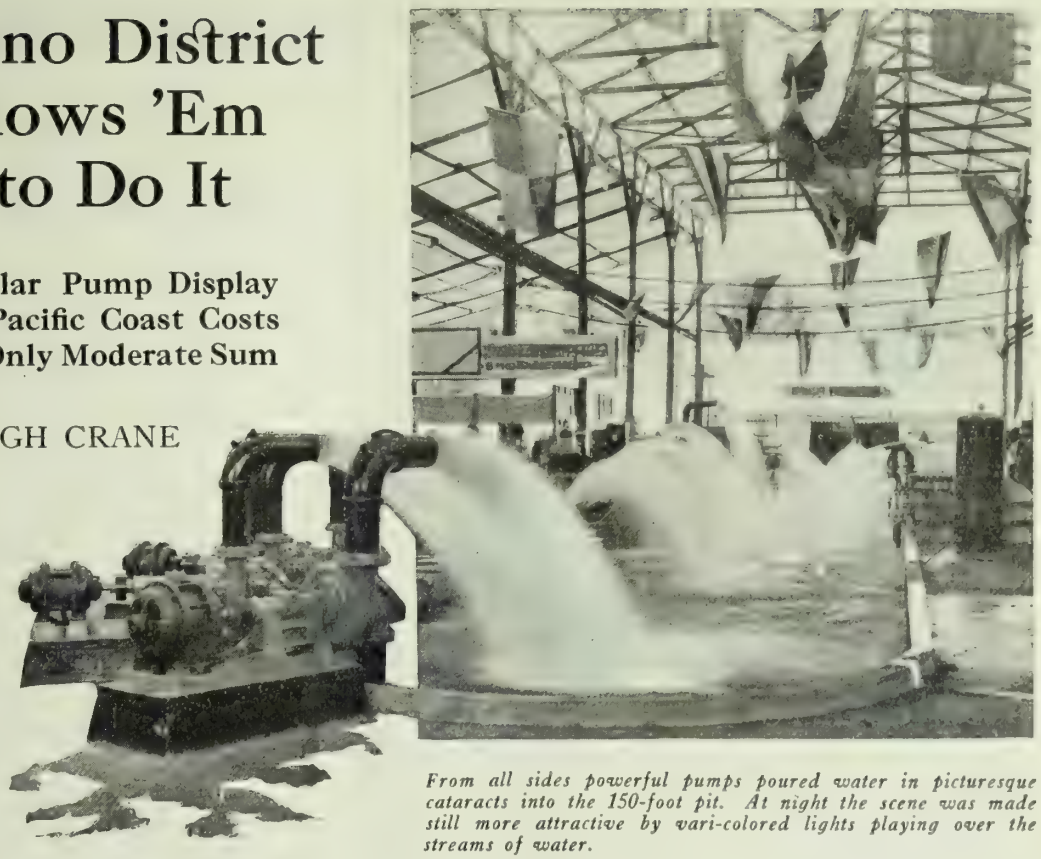
The Fresno District Fair Shows 'Em How to Do It

Most Spectacular Pump Display Ever Held on Pacific Coast Costs Management Only Moderate Sum

By HUGH CRANE



From all sides powerful pumps poured water in picturesque cataracts into the 150-foot pit. At night the scene was made still more attractive by vari-colored lights playing over the streams of water.

QUESTION: Is it possible for irrigation to be given something approaching adequate representation at a county, district, or state fair, without excessive expense? Can such representation be planned in such a way that the irrigation farmer who is interested in seeing a practical and helpful display of irrigation equipment may find his desires realized?

ANSWER: Yes,—the display of equipment planned and carried out at the recent Fresno District Fair, Fresno, California, affords proof that such an exhibit is possible, at moderate expense. Moreover, the Fresno fair serves as an excellent object lesson for similar organizations throughout the irrigation country.

MODERN fairs sometimes shoot wide of the mark in neglecting the primary purposes for which such institutions are established. Side-shows, catch-penny amusements, games of so-called chance, and horse races, too often eclipse the proper function of displays of agricultural and industrial products which should bring to the farmer and the manufacturer a chance to exhibit what they produce to those who are concerned in using those products.

To manufacturers and dealers in irrigation equipment in all parts of the west, and to irrigators, who have looked in vain at such exhibits as the California State Fair for representative displays of the new and up-to-date phases of irrigation equipment, the story of what was done at Fresno will come as an encouraging indication.

The Fresno District Fair has no money to throw away on extravagant displays for any industry. It is a self-supporting organization, operating at a small profit, assisted by small appropriations from Fresno County from time to time, and a state appropriation of $3700 per year for premiums. The state appropriation is, of course, a very small one compared with the annual appropriation of $85,000 for the state fair, held at Sacramento.

FRESNO, however, recognizes the importance of irrigation as the basis of all the products which make state and district fairs possible. Under the direction of A. V. Jordan, manager of concessions and exhibits, the Fresno fair this year planned and executed what has been declared the largest and most spectacular display of pumps ever held in California—and probably in the world.

A new pump pit was constructed in a central location, into which the exhibited equipment might pour as foaming streams of water in a picturesque cataract. The pit is 150 feet long, fifteen feet wide and ten feet deep, sides and bottom constructed of reinforced concrete. The concrete walls are six inches thick at the top and 12 inches thick at the bottom. The capacity of the pit is 170,000 gallons.

This tank, the total cost of which was only $4300 (defrayed by Fresno County), affords a total display of 328 lineal feet. The photograph appearing on this page gives a suggestion of the spectacular appearance of the exhibit when the pumps were operating. It was made still more attractive at night, when vari-colored lights were thrown over the streams of water.

Mr. Jordan, who has been active in making the Fresno District Fair a success for the past five years, declares that the pump display made a tremendous impression on both exhibitors and those who attended the fair as sight-seers.

"Our purpose has been," declared Mr. Jordan, "to anticipate the needs of exhibitors and to meet those needs in the interest of making the fair of maximum utility to those whom it is designed to serve. From the enthusiastic reception given to our irrigation equipment display in 1925, it seems assured that it will be necessary next year to lengthen the pit to provide additional display space. I am sure that all available space will be spoken for long before the 1926 fair opens."

MANUFACTURERS of and dealers in equipment in California have been particularly interested in the Fresno display on account of the example which it sets to the California State Fair, at which the attention devoted to irrigation in past years has been unsatisfactory.

(Continued on Page 35)

The EDITORIAL

MODERN Irrigation

An Organized Voice for the Forces of Agriculture and Industry Which are Primarily Dependent upon Irrigation.

Published Once a Month

AT LOS ANGELES, CALIFORNIA, BY THE

PETROLEUM WORLD PUBLISHING CO. *Editorial and Executive Offices, 626 South Spring Street, Telephone Broadway 3262.* Branches: SAN FRANCISCO—447 SUTTER STREET, *Telephone Garfield 2772;* H. E. TAYLOR, *Manager.* CHICAGO—1163 MONADNOCK BLDG., *Telephone Wabash 8855;* JOSEPH E. O'CONNOR, *Manager.* NEW YORK—503 FIFTH AVENUE, ROOM 308, *Telephone Vanderbilt 8753;* WERNER HAUPTLI, *Manager.*

OWEN BROWN, *President;* W. C. MONROE, *Vice-President and General Manager;* MINOR MOORE, *Secretary and Counsel.*

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Executive Editor

By Annual Subscription in the United States and possessions, $2.00; Foreign, $2.50; Single copies on sale in the irrigation country, 20 cents. In ordering change of address, give both the old and the new address. Allow ten days for re-entries on the subscription list. Advertising rates and circulation data upon request. Checks should be made payable to Petroleum World Publishing Co.

VOL. I NOVEMBER, 1925 No. 5

The Engineer

AN UNOFFICIAL observer, who sat through the two days of hearings of the Senate committee in Los Angeles during October and heard an immense mass of testimony from witnesses, including many different classes of men who have a common interest in irrigation and especially in the Colorado River, exclaimed, at the end of the second day: "What a difference between the testimony of the layman and the engineer! The engineers know what they are talking about."

Perhaps the remark was unkind to the men who testified who were not engineers. Many of them are men who have learned the lessons of irrigation in the stern school of experience, which offers some wonderfully practical courses based on the case system. But the observer's exclamation contains much truth, and suggests much more.

The engineer does know what he is talking about, and for that reason he is the man to whom the irrigation industry looks for safe guidance in its development. Without the engineer's advice the industry can not safely proceed.

The Key Man

THE KEY man in the forward march of irrigation is the engineer. The others have their indispensable roles to play—the financier, who accumulates the surplus of many investors and makes them available for the construction of large works, in turn to create new wealth; the executives, who bring to the direction of irrigation activities the results of their years of experience with problems of business and of agriculture; and the farmer, who invests his time, his labor and his very life in the effort. But each of these needs the counsel and skill of the technical man.

The conservation of our water supplies and their efficient applicaiton must depend, in largest measure, upon the men especially fitted, by training and experience, for the solution of these problems. They call for the highest degree of skill, knowledge and judgment. The engineer, all other things being equal, is the man best qualified to make sound judgments of such problems, by virtue of his specialized training and experience.

The study of water supplies and the methods of utilizing them is essentially the engineer's duty. In cases where the judgment of the engineer conflicts with the judgment of others, in such matters, it would seem the part of wisdom to support the engineers' conclusions until they are proved unsound or ill-founded.

There is not always agreement even among engineers. They may, and frequently do, differ in their conclusions over important questions, even after full consideration has been given to all the engineering and technical data available. Despite such discrepancies, the truth remains that men trained in these particular subjects are more likely to reach correct conclusions from the consideration of the physical facts of a problem than men not especially trained to analyze and weigh such data.

When a medical problem is involved, we turn unhesitatingly to the physician. If a point of law is at issue, we consult the attorney. In neither case do we feel that we can safely place our confidence in men not especially educated and experienced in these subjects. Should we not show something of the same confidence in the engineering profession?

The Fresno Fair

IN ANOTHER part of this number, a staff contributor has told of what was accomplished by the recent Fresno (California) District Fair in the way of working out a representative display of irrigation equipment. For a long time the equipment men have been impotently voicing their dissatisfaction at the inadequate attention paid to irrigation at the California State Fair, held annually at Sacramento.

In spite of the fact that the state fair is supposed to be primarily an agricultural display, and the further fact that agriculture in the west depends, primarily, on irrigation for its existence, it appears

POINT *Of* VIEW

that the management has been slow to recognize this industry. Irrigation's meagre displays have been poorly housed, carelessly planned and inconspicuously placed, far from the center of things at the fair.

It is useless to scold about the past; not only useless, but it defeats its own purpose. Manufacturers and dealers who want a better display of irrigation equipment at this state-wide exhibit of agricultural and industrial activities are willing to forget their past grievances, but they are most anxiously hoping for better things in the future. The fact that the Fresno District Fair, at comparatively little expense, has been able to give these manufacturers and dealers a display on a scale better calculated to represent the industry, is accepted as a happy augury of what may be expected at the Sacramento Fair. The Fresno Fair has shown that it can be done, and, with the determined insistence of the equipment men to influence them, the state fair officials will do wisely to see to it that future irrigation displays are planned on a scale more proportionate to the great industry on which California's prosperity is fundamentally dependent.

A Significant Decision

AN interesting decision has recently been rendered by the Federal Power Commission in the case of the conflicting claims of the Nevada Irrigation District and the Yuba River Power Company to water rights on the Yuba River, in northern California. In this case the two interests desired to use the waters of the middle fork of the river, the irrigation district seeking to divert the waters across the south fork of the river and to use them for irrigation and power development, and the power interests wishing to divert them to the north fork, where they could be utilized to advantage in connection with a major power development.

There was a conflict involved between the desire on the part of the power company to use the water for hydroelectric development, on the one hand, and the desire on the part of the irrigation district to combine both irrigation and power development in their use; although those who opposed the contentions of the irrigation district asserted that the irrigation use of the water would actually be secondary to its use for the generation of power, if the award were made to the district, which has a contract with the Pacific Gas & Electric Company which allows it to use the water of the district for power generation between the dams of the district and the lands to be irrigated.

The diverse claims were advocated strongly over a four year period before the Federal Power Commission and the California Division of Water Rights. An earlier decision of the Power Commission granted the application of the Yuba River Power Company, but at a recent hearing it revoked that decision and made a new ruling recognizing the superiority of the irrigation district's claims. The decision of the Federal Power Commission, "after full consideration of the information presented to it by its staff" authorized the issuance of a license to the Nevada Irrigation District. The action was in accordance with the laws of California which give preference to the use of water for irrigation over its use for power.

In this decision the Federal Power Commission has ruled wisely. Important as is the development of power—and, indeed, irrigation and power are interdependent and complementary, not antagonistic—irrigation is nevertheless the more essential; and where there appears such a conflict as existed in this particular case, the irrigator must be given the prior right to make use of nature's resources.

It's Always Important

A CORRESPONDENT has written to the editor approving some of the material published in recent issues on the subject of forest protection and reforestation. He affirms his belief in the value of such articles as have appeared from time to time, and makes a suggestion dealing particularly with the reforestation of lands contiguous to dam sites. Writing from San Diego, California, he declares:

" 'Forest fires' (meaning, often, the burning off of large areas of brush) in such sections as San Diego County add to a bad enough condition. I have visited every dam site in this vicinity, for instance, and none of them are surrounded by forests as they should be. Waste land is all about them —and no trees. Yet we hear it said that 'condensation loss' is unavoidable. I have 'talked my head off' for years, but it is of no use. Somebody should be doing something *now* for our grandchildren and their great grandchildren. I should like to see you publish lists of suitable trees; where seeds may be produced; how and when, and where they should be planted, etc. . . . In some way we should be getting action on conditions around dam sites and impounded waters. Water taken out of these reservoirs to start the growth of trees should prove a good investment, it seems to me, and it would provide work for the dam watchman, who could plant and water the trees. . . . Cannot you get some strong articles covering this condition, and persistently publish something in each issue concerning the value of reforestation?"

MODERN IRRIGATION has repeatedly declared itself on this important subject and is glad of the opportunity to reaffirm its faith. Reforestation is a policy on which there is no room for argument, but much need for action. By articles already published on various phases of the problem we have begun to do what we can toward advancing the gospel which our San Diego friend carries so near to his heart, and we have only just begun to fight. We shall continue to wield whatever influence these columns can command in the interest of doing something to protect the interests of the "grandchildren and great grandchildren" to which he refers.

Methods and Standards of Service Installation

Superintendent of Meters and Service Discusses Practices of Los Angeles Department

ONE OF THE interesting and practical papers presented to the Sixth Annual Convention of the California Section, American Water Works Association, at Santa Cruz, in October, was a discussion of service installation methods and standards as practiced by the Bureau of Water Works and Supply of the city of Los Angeles. The paper was prepared by George Read, superintendent of the meter and service department of the bureau, and was read before the convention by A. P. Lovell, water superintendent of San Diego.

At this date—the paper began—all domestic water connections for new subdivisions are being installed by laying a pipe from the main to just inside the curb on the dividing line of the two lots, equipped with two outlets.

On cast iron water mains, a saddle having a 2½-inch female standard iron pipe thread, is strapped to the main. On cast iron mains from 12-inch and up, a bronze saddle is used on account of safety. On sheet steel or iron main, a heavy coupling is electrically welded and takes the place of a saddle.

INTO saddle or coupling is screwed a bronze corporation cock having a male 2½-inch standard iron pipe thread on one end and a leaded bell and outer 4-inch standard iron pipe thread on the other. The outer standard 4-inch thread is used for tapping purposes and can also be used for the laying of standard screw pipe. Five-foot lengths of 2-inch cast iron pipe, ¼-inch thick, weighing 6½ pounds per foot, with lead prepared joints, are then run from the bell end of the corporation cock to just inside of the curb. We have tested this pipe to over 1,000 pounds per square inch.

The five-foot length that ends just inside the curb has a two-inch standard iron pipe threaded end on which is screwed a two-inch cast iron elbow. Into this elbow is screwed a two-inch galvanized iron pipe riser about twenty inches long equipped with 2x2 cast iron tee; the latter being equipped with bronze bushings reduced to the size of the services required at the date of installation. Bronze bushings are used on account of ease of removal, etc.

Both these outlets can gradually be enlarged up to 1½-inch without digging in the street and if both lots are acquired by one person and a large building is to be erected, the service can be made into a two-inch.

When tapping large trunk lines a two-inch shut-off is placed just inside of the curb, to be used when enlarging a service; otherwise, small mains are shut off for a few minutes while making enlargement.

In new subdivisions where we are not sure of the location of driveways, a ten-foot piece of galvanized iron pipe, equipped on each end with a curb cock, is run both ways from the tee on the riser. Curbcocks that are not immediately put in use are sealed and can be used for flushing purposes, if it ever becomes necessary.

GALVANIZED iron or steel service pipes already installed in streets that are to be permanently paved are being renewed in the same manner, and the Department is endeavoring to have an ordinance framed that will make it compulsory for all vacant lots to be served in advance of the paving. The cost of such installation may be included in the assessment for the street paving. Public sentiment is in favor of all utilities being installed in advance of paving.

This method of service installation means good supply to the curb; it practically eliminates the cutting into paving for the renewing and enlarging of service pipes and it means low maintenance cost. It also means one-half the present cost to the consumer, when enlarging is necessary. Its construction is identically the same as for standard cast iron water mains. At this date we have used for service installation 233,500 feet of this cast iron service pipe.

The average cost per two-inch cast iron service including the fittings, etc., for two supplies taken from same for ¾ and 1-inch sizes, is $34.25 each. This cost includes 10 per cent for supervision, etc.

Galvanized iron pipe is used instead of cast iron for hillsides and fills. This pipe is asphaltum painted, wrapped with burlap and repainted. Single installations scattered over the city, are being installed with galvanized iron pipe. Standard corporation cocks are inserted into cast iron mains up to 1-inch. Above 1-inch, saddles are used on cast iron mains and couplings electrically welded on sheet steel and iron mains of large diameters. Couplings are also electrically welded on standard screw mains carrying heavy pressures.

PRESSURE regulators are placed on services carrying over 125 pounds. These regulators are placed in front of the meter, at the expense of the consumer. They are maintained by the Department, but the Department is not responsible for damages caused by their getting out of order.

Lead goose necks have practically been eliminated. The coupling nut tail piece formerly used for lead flanging is now threaded, into which a street elbow is screwed and left looking downward. A short piece of pipe reaching the bottom of the excavation is then screwed into same, which is equipped with a swinging joint to connect to pipe leading away to the curb. The whole idea is to make the connection so that it will not be sprung by the settling of the earth. A fairly hard rubber gasket that will stand steam is used in connecting the coupling nut to the corporation cock.

The few leaks that we have had were not due to this method. We consider this method superior and cheaper to the lead goose neck because when a coupling nut is screwed up tight on a lead goose neck, the lead goes on compressing, due to tension, and in a short while becomes loose so that a little settling of the earth starts a leak.

Galvanized iron service pipes are laid by hydraulicing, driving or digging a ditch. The soil conditions, etc., determine the method. A truck carrying an air compressor, equipped with paving breakers, cuts the paving in advance of the service crews. This is costing the Department 22 cents per square foot. Services larger than two-inch for domestic, commercial, irrigation or fire protection, are all taken from the main by either clamping or welding on a heavy coupling. A tapping nipple is either leaded into a clamp or screwed into a coupling. A gate is placed on the tapping nipple through which the main is tapped. Tapping machines from 1½-inch to 8-inch are made by the Department and an 8-inch service is the largest we have at this date.

WROUGHT iron pipe is used for irrigation services and cast iron for all other purposes. When a fire service is installed, a tee is placed on same just inside of the curb for the domestic supply, and a gate is left controlling the fire line into the building and also a gate to control the domestic supply. By

(Continued on Page 44)

THE IRRIGATION DIGEST

A Monthly Bulletin Board of Brief Facts and Events from Far and Near

Big Return on Cotton

Farmers on the Elephant Butte Irrigation Project will receive more than $12,500,000 for their 1925 cotton crop, according to estimates made by El Paso (Texas) bankers. The estimated cotton production on the project for the year is 100,000 bales.

Directors Trial Postponed

Trial of the four directors of the Imperial Irrigation District who are accused of malfeasance in office in connection with the alleged misuse of district funds in the interest of the Swing-Johnson bill has been postponed until January 11 by Judge Franklin J. Cole, who is hearing the case.

Rains Cause Canal Break

Recent heavy rains in the neighborhood of Calipatria caused a thirty-foot break in the east highline canal of the Imperial Irrigation District and a number of minor breaks in waste and lateral ditches. Crews rushed to the scene remedied the trouble and repaired all the breaks without interrupting the delivery of water.

To Form 8,000-Acre District

Farmers of Santa Cruz Valley, New Mexico, are planning for the creation of an irrigation district to embrace 8,000 acres in Santa Fe and Rio Arriba Counties. An election early in November will decide whether or not such a district will be formed. The tentative plans of the district are to build a storage reservoir by damming the Santa Cruz River.

Plan Northwest Compact

At a meeting of state and federal hydraulic engineers at Spokane, Washington, on October 31, preliminary plans for a four-state compact for the division of the waters of the Columbia River were to be drawn up. Representatives of Washington, Montana, Idaho and Oregon met at the Chamber of Commerce Building with R. K. Tiffany, state hydraulic engineer of Washington, to discuss interstate irrigation problems related to the Columbia's waters.

Chino District Plans Dam

The Chino Valley (Arizona) Irrigation District has been authorized, following an election at which the proposed issue was endorsed by the land-owners of the district, to bond itself for the construction of the Willow Creek Dam. The proposed dam is expected to cost about $40,000 and the bond issue will probably be about $75,000.

Dam Construction Progresses

Construction work on the Continental Reservoir Dam of The Del Norte, (Colo.) Irrigation District will be completed in early 1926. The dam is of the earth and core-wall type and when completed will give storage capacity of 32,000 acre-feet. The work on the diversion dam across the Rio Grande River was done in 1924-25, and the main canal and laterals completed in 1925. Carl A. Gould is engineer in charge of construction.

East Bay District Sells Bonds

An issue of $5,000,000 in bonds of the East Bay Municipal Utility District, California, was recently sold to a banking syndicate headed by the Bank of Italy and including, among others, W. R. Compton Co., Marshall Field, Glore, Ward & Co. The winning bid carried with it a premium of $110,000. The second and only other bid was made by a National City Company group; its bid carried a premium of $75,000. The bonds are a five per cent serial issue.

Dynamite to Block Leaks

An unusual hydraulic feat was attempted recently in the Tumalo, Oregon, Reservoir. The reservoir was losing considerable water through underground caverns, and the engineers in charge attempted to block these leaks by the explosion of a large quantity of dynamite in the caverns. The reservoir gates were first closed for three weeks, to provide a sufficient head of water. Several boxes of dynamite were then floated into the hill where the leak existed, and exploded. Whether the experiment was successful or not has not yet been determined.

Reservoir For Hood River

The Hood River (Oregon) Irrigation District, at a recent meeting of directors and taxpayers, decided to proceed with plans for the construction of a reservoir, without which the district will suffer for the lack of adequate water supply. The work will be extended over a period of several years, according to the scheme outlined by the district, $10,000 to be devoted to the first steps.

Changes Will Save Money

Changes in the power plant of the Donna Irrigation District No. 1, Hidalgo County, Texas, will save the district $20,000 a year in operating expenses, according to Engineers W. T. Shaw, of Mercedes, and A. Tam, of Harlingen. The three pumping plants of the district are to be provided with electric motors, replacing internal combustion machines. The cost of the substitution will be about $50,000.

Idaho Officials in Meeting

Plans for supplying lands between Pocatello and American Falls with irrigation water were discussed at a recent meeting of state, federal and Indian officials of Idaho, at Pocatello. Some of the lands under discussion are located on the Fort Hall Indian Reservation. Under the original plans for the American Falls development part of these lands only were included under the project. Recent changes, according to Warren G. Swendsen, state reclamation commissioner, will bring all these lands under irrigation.

1925 Fire Loss Reduced

Fire statistics for California, issued by Paul G. Reddington, United States district forest supervisor for California, show a material decline in fire loss for the summer of 1925.

While the total number of fires for 1925 was 1844 as compared to 1805 in 1924, suppression expense amounted to only $151,807, as against $678,687 for the previous year. Another striking contrast exists in the total burned area inside and adjacent to the national forest lands. For 1925 only 90,335 acres suffered, while during the previous year 601,628 acres were burned.

Geological Survey Publishes Report on Colorado River

E. C. LaRue is Author of Comprehensive Work Summarizing Study During Fifteen Years

The Department of the Interior has just issued a comprehensive report on the Colorado River as a result of engineering studies by the Geological Survey. The author is E. C. LaRue, hydraulic engineer, who has made a study of the river during the last 15 years, in the course of which he has made boat trips aggregating nearly 2,000 miles along the river and its major tributaries, including the whole of the Grand Canyon.

The basin of the Colorado, declares the report, affords the second largest concentration of irrigable lands and water power sites in the United States. Irrigation in the basin has been extended slowly but steadily until more than a third of the land irrigable from Colorado River is now receiving water. With the river as now regulated the present irrigation consumes the entire low-water flow, and in occasional dry years there is a water shortage.

Further development of irrigation is dependent on storage of flood waters and regulation of discharge. The power resources of the Colorado are as yet practically untouched, but a heavy demand for electric energy in the Southwest is now about to force a rapid development of all available power sites on the Colorado within reasonable transmission distance of the markets. As with irrigation, so with power, less than a third of the potential energy can be developed unless storage of flood waters and regulation of discharge are provided for.

The report points out that the Colorado River at present is not only a source of water supply for hundreds of thousands of acres, but a menace to these lands. The danger of a recurrence of flow to Salton Sea repeating the disastrous breakover of 1905, is ever present, and the safety of great areas of highly productive land and prosperous towns can be assured only by storage of flood waters and maintenance of a well designed system of levees and the bank works protection. Thus safety from inundation, complete use of waters for irrigation, and adequate development of potential power are all factors which demand storage and regulation works.

The Geological Survey report is published as Water Supply Paper 556. It deals with the comprehensive development of Colorado River below the mouth of Green River, with particular reference to flood control and the development of hydroelectric power. Records of stream flow are summarized, and estimates of water supply available at many points under a variety of conditions are presented. The principal reservoir sites are described, and their availability and usefulness are discussed. Plans, cross sections, and area and capacity curves, together with engineering and geologic discussions, are presented for all known dam sites on nearly a thousand miles of river, all of which has been surveyed and mapped.

Hydraulic Engineers In Washington for Annual Meeting

Geological Bureau Men From 22 States Discuss Matters Related to Their Work in All Parts of Country

District hydraulic engineers of the Geological Bureau from twenty-two states and Hawaii gathered in October at the Interior Department in Washington for the regular biennial Washington meeting.

After conferring with the Chief Hydraulic Engineer of the Bureau on matters of technique and policy relating to the investigation of the water resources of the United States, the engineers held a meeting with Secretary Work.

The problems considered by the engineers during the conference in Washington involved matters of water supply related to river regulation or flood control, irrigation, drainage, waterpower, and municipal water supply. This includes the measurement of the flow of rivers and their tributaries throughout the United States covering long periods of years—in almost all states. A large part of the work is carried on in cooperation with the states, the state organizations generally more than matching the Federal expenditure for the work.

At the present time some thirty states are cooperating with the Federal government under this arrangement and more than 1,700 stream measuring stations are being maintained throughout the United States and Hawaii.

Counts State's Trees

M. B. Pratt, state forester of California, has concluded a job compared to which any of the labors of Hercules were child's play. He has counted the number of trees in the forests of the state, and in a recent statement declares that there are 569,000,000 of them. The total, which includes only trees over 18 inches in diameter, represents the stand of commercial timber in California and involves 284,505,000,000 board feet. The estimate does not include ornamental and shade trees.

Complete Silt Survey of Roosevelt Reservoir

Accumulation of 101,000 Acre Feet in Twenty Year Period Revealed by Investigation

The Salt River Valley Water Users Association has just completed a silt survery of the Roosevelt Reservoir, showing a total accumulation of silt in the twenty years since the dam was begun, of 101,000 acre feet. This is a reduction in the capacity of the reservoir of less than 1-16 of the total, and at that rate it would take 320 years to completely fill the lake. Officials of the Association state that while it would seem at first thought that the present generation need have little concern as to the usefulness of the reservoir being greatly decreased by the deposition of silt, this is not the case. The use of 100,000 acre feet of water stored in Roosevelt Reservoir has a very high value for power alone. Run through the entire power system of the project, including the Horse Mesa and Mormon Flat plants, this would represent some 35,000,000 k. w. h., or a value of around $250,000. This amount would be available on an average over every three-year period. Therefore from this standpoint alone the loss of power revenue would make decrease in storage capacity at Roosevelt a serious consideration to the present day water user.

The present silt survey is one of four made since the dam was built, the others being made in 1914, 1916 and 1919.

Three Counties Apply For 250,000 Ac. Ft. on Santa Ana

Southern California Conservation Body Plans to Protect and Conserve Water Supplies

The collective determination of three Southern California counties to conserve and protect their present and future water supply is manifested in the recent application by the San Bernardino, Riverside and Orange Counties Conservation Association for 250,000 acre feet of water from the Santa Ana River watershed.

In the application the association sets forth that the water is to be conserved in surface and sub-surface reservoirs and retained by check dams and other means, from the crest of the San Bernardino mountains to the point of discharge of the Santa Ana system. The water will be used in supplementing irrigation water on land already irrigated, and for maintaining and increasing the domestic water supply of San Bernardino, Colton, Riverside, Orange, Santa Ana, Placentia, Anaheim and Huntington Beach.

New Officials Named to Lead Oregon Reclamation Body

The Oregon Reclamation Congress, (formerly the Oregon Irrigation Congress) elected a new president and secretary in a spirited session which concluded their three-day session at Grant's Pass early in October.

In a close contest for the presidency of the organization, Wilford Allen, of Grant's Pass, was elected to succeed James M. Kyle, of Stanfield. W. L. Powers, of the Oregon Agricultural College, Corvallis, was unanimously named secretary, succeeding Walter E. Meacham, of Baker. Prof. Powers has been prominently identified with irrigation and reclamation activities in the state and for ten years has been secretary of the Oregon Drainage Association.

According to the recently adopted constitution of the Congress trustees must be elected by each of the three districts into which the state has been divided, to represent their respective sections in the work of the Congress. The first congressional district, comprising western Oregon excepting Multnomah County, has named the following as trustees: Olin Arnspiger, manager of the Talent Irrigation District; Ralph Cowgill, engineer of the Medford Irrigation District; J. W. Lucas, manager of the Chicago Land Company; Rhea Luper, state engineer of Oregon, and J. T. Jardine, director of the state experiment station at Corvallis. The third congressional district, which is coterminous with Multnomah County, has chosen R. M. Townsend, George Myers, John Beall and C. G. Brownell, with Marshall Dana, of the Oregon *Journal,* as chairman of the group and a member of the executive committee of the Congress. Each of the three groups will name a chairman, who will automatically become a vice-president. With the president and the secretary, these three chairmen will comprise the executive committee.

Approve Idaho Issue

The Idaho Reclamation District Bond Commission has approved the certification of $159,000 in bonds issued by the Jefferson Irrigation District. The district has 5000 acres of land, of which about 1000 is under cultivation. Water is obtained from Jefferson reservoir, North lake, and artesian wells. The district proposes to take $150,000 from the proceeds of the bond sale and purchase and improve the irrigation system. The remaining $9000 is to be used to pay the first year's interest on the bonds.

Building an Industrial Empire *with Water and Concrete*

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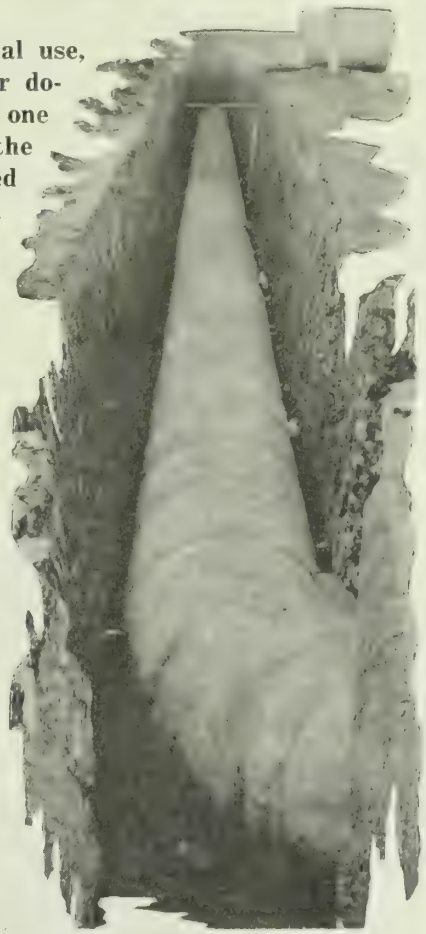

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IRRIGATION MANAGEMENT

CHECKING WATER LOSSES ON IRRIGATED LANDS

HOW MUCH of the water diverted for irrigation use ever gets to the plant in beneficial form is a question that has repeatedly been investigated and discussed, and frequently measured with a fair degree of accuracy, but is always an important and practical question for the irrigator. Recent investigations on irrigation enterprises in Washington have revealed some interesting results.

The losses between point of division and point of delivery to the farm have been more or less accurately measured on many government projects and numerous private systems. On the Sunnyside division of the Yakima project, for instance, the average of the total conveyance losses for the last three years have been: 28.4 per cent for 1922; 27.5 per cent for 1923, and 27.9 per cent for 1924.

The losses which occur, however, after the stream reaches the farm have not often been measured. In fact, they have scarcely been investigated or realized, and in most cases they are difficult to measure accurately.

The sequence of these losses from the farm may be listed as follows: (1) seepage and evaporation from the farm ditches and flumes; (2) evaporation from irrigated fields; (3) deep percolation losses from the irrigated fields—below the feeding zone of plants; (4) surface run-off.

ON The irrigation branch experiment ment farm at Prosser an attempt has been made this year to measure some of these losses. The seepage and evaporation loss from one of the farm irrigation lines which consists of 285 feet of earth ditch and 725 feet of 10-inch flume was measured by discharging the water over one cippoletti weir at the head of the line and over another at the foot of the line. The difference between the two measurements represent the loss by seepage, leaks and evaporation. Both ditch and flume are kept in fair condition. The amount of water carried varied from 0.5 to 1.5 second feet. From all the measurements made during the season the average loss was 6.0 per cent.

Evaporation from non-cropped irrigated fields was measured by means of six small checks or basins to which measured quantities of water were applied. The basins were 30 feet square, each surrounded by a dike about 12 inches high. Soil moisture determinations were made to a depth of six feet immediately after irrigation and again 21 days later. The difference in moisture found in this 6-foot blanket of soil between the two sampling dates was considered to represent the loss by evaporation—when there was no percolation below the sixth foot. The average of these results show a 35 per cent loss.

It can not be said that the percolation was measured. It was estimated. The estimate was based on previous experiments which give fair knowledge of the water holding capacity of the soil, the evaporation rate of water from the soil, and the time it takes for irrigation moisture to come into equilibrium with gravity. This estimated percolation loss amounted to 16.5 per cent.

SURFACE run-off was measured by catching it from one plot at a time in one channel and passing it through a submerged orifice equipped with a Lyman meter which records the discharge in acre feet and fractions thereof. This loss averaged 12.5 per cent.

To summarize these results then, the total loss through the four sources mentioned in the foregoing, was 70 per cent. This leaves only 30 per cent of the water received on the farm for actual use by the crop plants. And only 21.6 per cent of that diverted from the source.

Duck Clubs Are Problem

At a recent meeting of the permanent committee of the Sacramento-San Joaquin River Problems Conference, detailed consideration was given to the problems incidental to the duck clubs on the Sacramento River. Fifty gun clubs have been appealed to for co-operation in increasing the flow of the river, with only fair success, it was reported. During the last two seasons the use of water in filling duck ponds has conflicted with the needs of navigation and irrigation. Suggestions were made for various means of eliminating this conflict, including the shortening of the duck season by fifteen days. The duck season now begins on October 1, and it is believed that the opening date should be postponed to October 15.

Irrigation Important Operation in Growing Good Alfalfa

Interesting Data on Water Demands of This Crop are Revealed by Recent Investigations

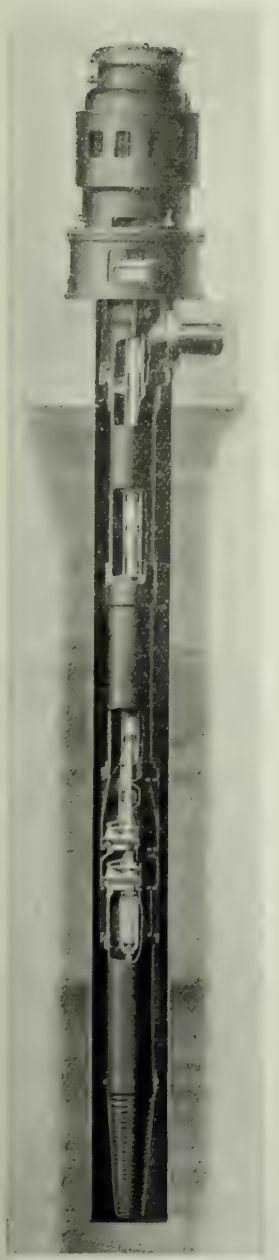
Growers of alfalfa, declares an exchange, are almost without exception greatly interested in irrigation for irrigation is usually the most important operation involved in growing a successful crop.

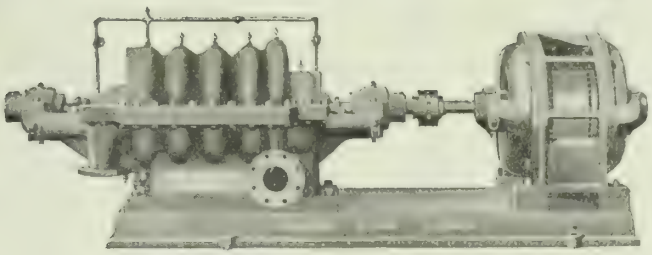
Large and profitable yields are not grown without plenty of water, correctly applied; yet in many parts of the alfalfa growing districts water is limited in amount and expensive to use. The practice of the most rigid economy consistent with adequate irrigation is therefore essential.

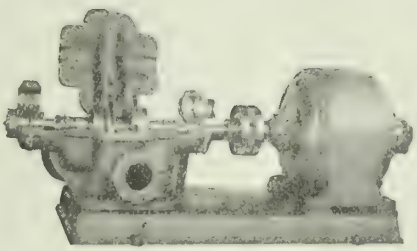
Five hundred pounds of water are required to produce one pound of cured alfalfa hay. If a yield of 1.5 tons per cutting is secured it would require 500 times 3000, or 1,500,000 pounds of water per cutting. This is equivalent to 6½ inches of water and represents ordinarily for a sandy loam a little more than one-half of the available soil moisture for plant growth in the upper six feet of soil.

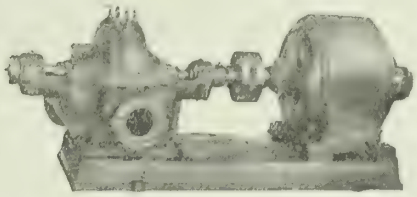
The depth and extent to which water has penetrated may usually be determined 24 hours after irrigation has stopped. The movement of water stops

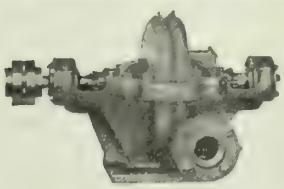
Pacific Pumps

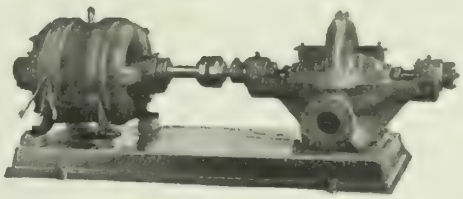


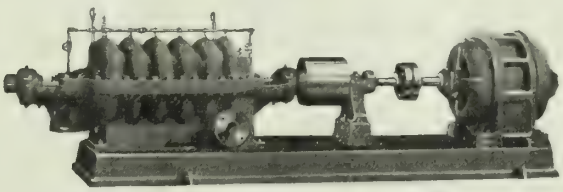












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when the soil is filled to its maximum water-holding capacity with practically no movement of capillary water from a wet to a dry soil (except from a free water surface as in the case of a high water table).

THE Irrigation Division of the University of California has been carrying on an extensive survey concerning the irrigation practices in the Sacramento Valley. The following are some of the data which were collected: Silt loam with a sandy subsoil is usually irrigated four times and 15 inches are applied for each irrigation. Of this 15 inches only 5½ inches was retained in the upper six feet of soil which is equivalent to 37 per cent. Six to eight inches would have been sufficient, applied once or twice during the growing season. On the clay loams four irrigations were applied with 8.78 inches per irrigation. Forty per cent of the water was retained in the upper six feet of soil. One or two irrigations of 4 to 6 inches should have been applied. The heavy clays were found to have been irrigated eight times with 3½ inches per irrigation. Four to eight irrigations, applying two inches each time should have been applied.

In any investigation of the proper duty of water, the size of the irrigation head used, and its relation to the type of soil, the method of irrigation followed and the size and slope of the areas watered with a single head are naturally always important. Fields may be well prepared and evenly surfaced and yet the results will be excessive waste or inadequate irrigation if the amount of water turned into each check is too large or too small. It may well be asked, What becomes of the water applied on many of the Sacramento Valley fields? It is obviously important that it is necessary to stabilize the irrigation heads used with reference to the size of check and the character of the soil. Data collected from twenty-five fields in the Sacramento Valley furnished information on this particular problem. Five classes of soil were covered, gravelly loams, sandy loams, silt loams, clay loams and clays.

From an investigation of the data gathered in these investigations, it is evident that the most desirable head of water to use on any given soil can not be adequately determined by comparing use on different fields. The present general practice in Sacramento Valley, expressed in cubic feet per second per acre, is, however, satisfactorily indicated from the average figures obtained, namely, 23 for gravelly loams, 10.9 for sandy loams, 8.8 for silt loams, 7.3 for clay loams, and 3.2 for clays. The difficulty of irrigating porous soils with small heads and of irrigating clay soils with large heads is well recognized among irrigators, even if the most satisfactory relationships have not been worked out in detail.

A COMPARISON between irrigation heads and depths of application on single fields makes it plain that in many cases either the head of water used should be increased or the area of the checks should be reduced. In summarizing, it was found, with a few exceptions, that in each instance where the soil was sandy loam, or silt loam, the depth of water applied increased as the rate of application decreased. In one case where a relatively small head was used, a depth of three feet of irrigation water was used before the surface of the field was flooded. In four cases, more than two feet of water was applied per irrigation and in 14 cases out of 27, the depth of each irrigation exceeded one foot. Measurements of the amount of water required to cover a one acre check having a slope of 3½ inches per 100 feet were made at Davis, California.

Data obtained were as follows:

Rate of application, cu. ft. per sec. per acre	Depth of water required, ft.
4.6	2.75
10.1	1.86
13.5	1.1
15.3	0.84
17.8	0.69

Until the proper relation between irrigating heads and size of check is worked out, there is certain to be much difference of opinion as to whether small checks and small irrigation heads, or large checks and large heads should prevail in alfalfa irrigation. In the case of individual pumping plants which rarely discharge more than one or two cubic feet per second, checks necessarily are small. Thoughtful consideration on the part of irrigators will in time work out the best ratio between the head of water to use and the size of check. It is clear, though, that the irrigation head can not be a constant quantity but must be varied where practical with the different soils found on nearly every farm.

WASTE WATER UNNECESSARY UNDER THIS SYSTEM

By NEWTON HIBBS
Twin Falls, Idaho

IT IS MOST important to allot and deliver to the land the minimum quantity required to procure the highest return for the water regardless of maximum possible production of the land. Necessity will then force extreme conservation on the part of the farmer.

Several years of experience in power pumping at a high cost made me a water conservationist. I learned to apply the irrigation water evenly to every unit of the field and to waste none of the costly crop requisite.

The fact that waste water causes great loss of fertility from the soil through which the water drains, waterlogs the catch-basin areas, and causes great expense of drainage makes the elimination of waste water a matter of great economic importance.

Nobody will dispute the logical fact that the determination of the crop demand is practicable under all conditions of soil structure, topography, and climate. Also that infinite care and labor would make even distribution of the allotted water possible. And if no more water is supplied than the crop demands and consumes, there will be no waste water. Economy of distribution then becomes the problem to be solved to eliminate an estimated 10% waste under present irrigation methods.

AS A MATTER of fact, I have demonstrated economy of distribution while permitting no waste in fields under many varying conditions of topography. On steep fields I run supply ditches without grade, like terraces, on the slopes distanced apart to be most convenient for corrugation water runs. These terrace ditches are permanent with flat side slopes. The corrugations row-distances apart extend between terrace ditches.

The water is dropped from one level to the other through the corrugations between the irrigated rows. The terrace ditches distribute the water to the corrugations over tufts of sod used as headgates for diversion. Blue-grass sod is the best diversion gate for equal distribution of small row-flows of irrigation water. Tufts of sod used for water diversion grow and become permanent. This sod distribution appliance is cheaper and better than any other diversion appliance known to me.

This terrace example is used here to illustrate my general system of water distribution. If the field is not steep I

would prefer water row runs of about 250 feet between these terrace ditches. If the field is steep or has uneven planes the water run must be determined by topography.

WHEN the terrace supply ditches are once "set" the sodded diversions automatically control the waste water. The sod "sets" are permanent for one season and practically so from one season to the next. Water turned in the higher terrace and redistributed in succeeding terraces to the row corrugations is automatically regulated in quantity at every terrace ditch to meet the demands of every row corrugation below. One man can efficiently attend 10-acre fields with appropriate water heads during the time required to irrigate such fields, unless the field grades are very irregular, and the row runs are necessarily very short.

To save time and water I provide a distribution trench at the border of the field to dam any water that might waste from neglect. From this foot terrace I make every corrugation a ditch in which the would-be waste water may back up in all trenches which are not supplied with water of equal amount from above. The higher sections of the field, while requiring regulation, may be evenly irrigated before the water is shifted to the next lower section. Any excess of water in different corrugations will be taken up by the next lower terrace for redistribution, but the flow is readily made practically even in all corrugations by timely regulation at the point of the row diversion.

WHEN the distribution of water is effectively under control the cost of irrigation of fields of uneven grade is not greatly excessive. It is more expensive to install an automatic system of distribution for rough fields than for smooth fields, but the cost of irrigation is not great in any common case.

To make this effort more comprehensive I might describe my system of distribution as a system of terraces whether the field is level or steep. The water is run through corrugations in short runs and redistributed to a lower corrugated section of the field. From one terrace the water is dropped to the other in small streams, so small that even the cultivated soil will not be "washed." This flow should be regulated according to grade. When the rows have all been evenly irrigated in one section of the field the water will be dropped to the next lower terrace ditch, by a supply ditch, but not through the corrugations.

Such a distribution system may be cheaply constructed by ordinary plows and corrugators, and no technical labor is required.

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HYDRAULIC ENGINEERING

Dealing with the Practical Problems of the Operating and the Consulting Engineer

A DISCUSSION OF PERMISSIBLE CANAL VELOCITIES

By SAMUEL FORTIER and FRED C. SCOBEY

THIS ARTICLE is an abstract, prepared by the authors at the request of MODERN IRRIGATION, *of their paper which constituted the final report of the Special Committee on Irrigation Hydraulics of the American Society of Civil Engineers, on the subject of permissible canal velocities, and which was published in the Proceedings of the Society. Both of the authors are known to irrigationists for their constructive work in the Division of Agricultural Engineering of the U. S. Department of Agriculture. Dr. Fortier was for eighteen years Chief of Irrigation Investigations under this division, and both are now stationed at the Berkeley, California, office of the Division.*

IN THIS paper, limiting velocity is taken to mean the maximum permissible value of the mean velocity. Although it is obvious that for any water prism the highest velocities are much in excess of the mean velocity, yet the only figure sufficiently tangible, under all conditions, for design and operation, is the mean velocity.

Silt is not considered as a specific gradation in soil sizes, but as a general term for all material brought into a canal by "muddy" waters. It is usually thought of, even in this sense, as different from sands and gravels. In other words, the "bottom load" is not included in the term as herein used.

The subject of limiting velocities for open channels has usually been treated under a heading combining the silting and scouring of channels. It has been considered that for each depth of water there is a certain velocity below which silt will be deposited and above which silt will be eroded from the bed of the channel. In the opinion of the writers, two phenomena only slightly related are thus confused. The power of flowing water to maintain a movement of separate soil, sand, or gravel particles, has been confused with the power to break the bedding of a canal bottom and ravel off particles of that bed and transport them to places of lesser velocities where they may be deposited. In their opinion there is no sharp line of demarcation between the velocities that can no longer maintain silt in movement and those that will scour a canal bed. It is believed that there is a broad belt of velocities within which silt already loosened or brought in through a head-gate will remain in suspension while the bed nevertheless will remain undisturbed as regards scour. It is easy to show the absurdity of accepting the laws of silting as giving the immediate answer to the laws of scour.

Certain of the canals of India, served by heavily silt-laden streams, were known to have reached a condition of permanent channel regime, neither silting nor scouring. In 1895, R. G. Kennedy offered his well-known formula:*

$$V_o = Cd^{0.64}$$

in which, Vo represents the "critical" mean velocity in feet per second, of a water prism, d ft. in depth, and C is a co-efficient. This so-called critical velocity is that for which there was no silting or scouring of the channel. The value of C is usually quoted as 0.84, but this coefficient was applicable for fine sand silt only; other coefficients for heavier materials range up to 1.09 for coarse silt or detritus from hard soils. Using the coefficient, 0.84, Table 1 may be developed.

A GLANCE at Table 1 shows the fallacy of accepting these velocities as the lower limit of scouring velocities. Mean velocities of 2½ to 3 ft. per sec. for general conditions are considered as most desirable in irrigation canals of the United States, yet Table 1 would indicate that a canal, 6 ft. deep, is the shallowest which would not show scour at the desirable velocities mentioned in the table.

Additional evidence against confusing the movement of particles by flowing water with the scouring action of that same water is contained in the following: The finer the soil particles, the slower may be the velocities that will maintain the particles in suspension. In practice it is found, that canal beds in stiff clays, classed by soil experts as being composed of particles of 0.005 mm., or less, in diameter, will withstand mean velocities approximating 4 ft. per sec., yet clear sand coarser than granulated sugar will be scoured at velocities of about one-half that, or 2 feet per second.

Some alluvial silts or loams will erode quite easily, when a canal is new, whereas some, of apparently the same size gradation, will not. The difference lies mostly in the presence or absence of effective colloidal matter Colloids, as applied to soils, give the properties of plasticity, cohesion, toughness when wet, and hardness when dry, that are essential to an erosion-resisting soil.

The presence in the water of an electrolyte, such as calcium or carbon dioxide, will flocculate the colloids and partly or completely annul the property of creating cohesion. Therefore, effective colloids are those free from the influence of an electrolyte.

THE property of a canal bottom to withstand scour is due to beds of different types, of which the following are examples:

1—Very fine silty or clayey particles so puddled together that there is distinct cohesion present; a homogeneous mass—the more colloidal matter present, the greater will be the cohesion.

2—Graded materials, the finer filling the voids of the coarser; ranging from the finest of silts to coarse gravel. Such a bed becomes very firmly compacted and will withstand velocities that would erode a bedding composed of any of the constituent particles alone.

3—Non-cohesive particles, without grading as to sizes. The unit particles may be of "sugar" sand or of cobblestone size; if free from colloidal silt or graded sizes a canal bed in such material may come nearest to following what Gilbert terms the laws of "competent velocities."

* Minutes of proceedings, Inst. C. E., Vol. CXIX (1895).

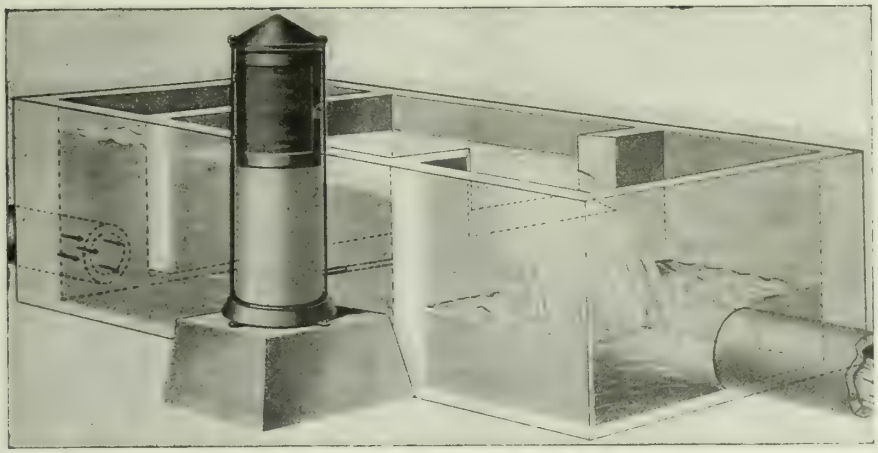

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TABLE 1

Depths, in feet	1	2	3	4	5	6	7	8	9
Velocity, in feet per second	0.84	1.30	1.70	2.04	2.35	2.64	2.92	3.18	3.43

A study of these types shows that the particular one to which any given canal will belong may or may not be determined by the materials excavated for the canal. It is finally determined only after years of use. Two examples will make this clear.

In the Imperial Valley of California many of the large laterals were excavated in a light sandy soil that would have scoured when the canals were new at a velocity of 2½ ft. per sec. The extremely fine silt particles brought in from the Colorado River prior to 1910 compacted and puddled this sand and plastered it with a coat of slick colloidal mud, so that it would withstand velocities in excess of 5 ft. per sec.; yet the individual particles of this slick mud were so fine that they would remain in suspension at very low velocities, except when the water was "overloaded" with silt—in times of flood on the Colorado River.

Many of the mountain valley canals of the Rocky Mountain States were constructed in loamy gravel soils. The present bottoms of these canals show little indication of loam. At the extreme edges, grass, roots, and low velocities combined have built up vertical banks of fine material, but the bottoms are of well-graded gravel, ranging from pea size to cobblestones, but all so well compacted and fitted together that a high velocity is feasible, far above that which originally washed out all the loam particles until a gravel paving resulted.

THE PROBLEM of plant growth is an important one in the operation of irrigation canals and deserves special treatment.

Few aquatic plants thrive in the absence of sunlight, therefore, canals carrying turbid waters are seldom bothered with plant growth. In clear-water channels some species thrive in velocities much greater than the channel soil will stand. Other species grow only in sluggish velocities. If, therefore, the highest permissible canal velocities as determined from the standpoint of erosion are provided, all that is possible will have been done to prevent trouble by plant growth as far as fixing velocities is concerned.

Thus far in this discussion the writers have endeavored to establish the fact that the determination of eroding velocities is a matter of empirical observation on erosion, not on silt deposition, to the time when a particle is broken off from the bed of the canal, the cohesion due to colloidal matter being overcome or the mechanical interkeying of various elements being disturbed. After that takes place, the data of Dubuat, Kennedy, Gilbert, and others may apply. The actual determination of these empirical data has never been attempted, as far as the writers are aware. That is, it has not been considered feasible to increase slowly the mean velocity in a canal of a definite material and thus determine the actual mean velocity at which scouring commenced.

The only data available are the facts that certain canals have scoured under relatively high velocities. The magnitude of these high velocities is known, but not the exact high velocity that started the scour. Undoubtedly, a higher velocity is required to start scour than to continue it when once started. Likewise, it is known that certain canals do not scour even if the mean velocity is two to three times those velocities suggested by Dubuat or Kennedy. It still remains to be determined how much higher a velocity this particular canal would stand before scour commenced.

Hence, at present, the best knowledge of scouring velocities comes from personal deductions as to the performance of individual canals and not from direct experimental work. With this understanding in mind, the committee submitted questionnaires to a number of irrigation engineers whose experience qualified them to form authoritative estimates of the maximum mean velocities allowable in canals of various materials.

AFTER a careful study of all the data presented and in the absence of experimental data bearing on the subject, the Committee recommends the values given in Table I for maximum permissible mean velocities. The figures given are for canals with long tangents predominating throughout their lengths. For the same canals if sinuous a reduction of about 25 per cent is recommended. Likewise, the figures are for depths of 3 ft. or less. For greater depths a mean velocity greater by 0.5 ft. per sec. may be allowed. The velocity in canals carrying water free from muddy silts, but bringing a powerful abrasive from the river, should be reduced 0.5 feet per sec. Canals from streams more or less silt-laden through the year, may be designed for full-load mean velocities from 1 to 2 ft. per sec. greater than would be permissible for the same material or new excavation, served by clear water from a reservoir. Deep canals conveying water with clean sand will develop destructive sand boils which would be absent in the same canal with clear water from a reservoir. In short, the character of water conveyed must be considered as well as the materials through which the canal is first excavated. In theories of "loading", clear water is best fitted to take on a load of scoured material and a water carrying a partial load of sharp abrasive is better equipped to start erosion.

The general basis of Table 2 is a tabulation of original soil materials in their order of ability to withstand erosion under usual conditions; that is, conveying relatively clear water, for the greater part of the season. In soil gradations finer than gravels, it is recognized that the resistance to erosion depends on the cohesion of individual particles, one for another. For the gravels—fine, coarse, and cobbles—the resistance is by virtue of weight and shape aided by the obstruction afforded one unit by its mixture with others. There is no element of cohesion due to plasticity, or stickiness, such as is found in clay. In graded materials, the canal bottoms become firmly bedded after a few years. At first, there being little plastic colloidal matter, the finer grained soils are washed free and carried farther down stream, to be de-

TABLE 2—PERMISSIBLE CANAL VELOCITIES

Original material excavated for canal. (1)	Velocity, in Feet per Second, after Aging, of Canals Carrying: Clear water no detritus (2)	Water bearing colloidal silts (3)	Water bearing non-colloidal silts, sands, gravels or rock fragments (4)
Fine sand (non-colloidal)	1.50	2.50	1.50
Sandy loam (" ")	1.75	2.50	2.00
Fine loam (" ")	2.00	3.00	2.00
Alluvial silts when non-colloidal	2.00	3.50	2.00
Ordinary firm loam	2.50	3.50	2.25
Volcanic Ash	2.50	3.50	2.00
Fine gravel	2.50	5.00	3.75
Stiff clay (very colloidal)	3.75	5.00	3.00
Graded, loam to cobbles, when non-colloidal	3.75	5.00	5.00
Alluvial silts when colloidal	3.75	5.00	3.00
Graded silt to cobbles, when colloidal	4.00	5.50	5.00
Coarse gravel (non-colloidal)	4.00	6.00	6.50
Cobbles and shingles	5.00	5.50	6.50
Shales and hard-pans	6.00	6.00	5.00

posited on the inside of curves or precipitated where velocities are reduced above check structures. At the same time, the gravel is moving slowly down stream, until finally a bed is developed in which voids are filled by smaller material. This graded bed is quite stable, entirely because of mechanical intermixture and not because of plastic cohesion, although as indicated in Column (3), the fact is recognized that the admixture of effective colloids will make the bed all the more tough and tenacious, increasing its resistance to erosion. The shales are taken as smooth, soft rock, resistant to erosion by clear water, but not so resistant when a sharp abrasive is carried by this water.

FOR EACH grade of original material shown in Column (1) the fact is recognized in Column (2) that the final condition of a canal bed must be quite largely determined by the material through which it flows and likewise the fact that there is little or no abrasive in the water. The figures in Column (3) recognize that the water contains effective colloidal silts. These silts will settle to greater or less extent under relatively high velocities. The difference between colloids and colloidal silts should be noted. The first will remain in suspension, even if all velocity be eliminated, for a long period of time, even years. The silts will precipitate under reduced velocities, and possess sufficient colloidal matter to form a plastic, highly cohesive mass. Obviously, such water will have a marked influence on the final character of the canal bed for all gradations up to the shales where the original material is more resistant than any deposit of silts. In Column (4), the figures indicate that waters conveying abrasive sand or gravel will make some materials more resistant by furnishing the constituents needed for a graded bedding. On the other hand, shales or slick tough clays are themselves resistant, and this resistance is reduced when a powerful abrasive is contained in the water.

Conclusions

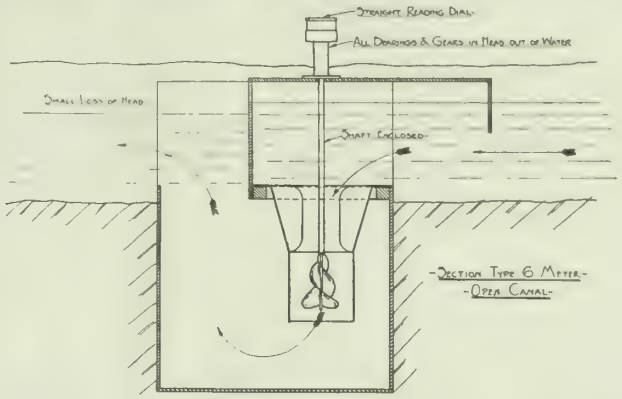
1—The laws of hydraulics governing the movement of loose silt and detritus in open channels are only distantly related to the laws governing the scouring of a canal bed and are not directly applicable.

2—The material of seasoned canal beds is composed of particles of different sizes and when the interstices of the larger are filled by the smaller, the mass becomes more dense, stable, and less subject to the erosive action of water.

3—The velocity required to ravel and scour a well bedded canal in any ma-

(Continued on Page 43)

THE **RELIANCE** METER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Section Type 6 Meter
Open Canal

THE RELIANCE IRRIGATION METER has been the standard low pressure Meter for 10 years—thousands installed throughout the irrigated sections of the West. Built in various types and sizes to fit all deliveries on canal and pipe systems. Easy to install—easy to read. Straight reading cubic foot or acre foot dials. Simple in construction, few and slow moving parts—upkeep negligible. No bearings or gears under water—small loss of head. Unaffected by dirt and floating debris in water. There is a size and type to settle your measurement problem.

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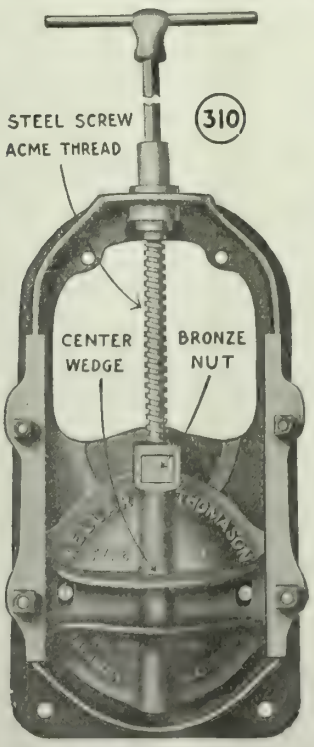

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Center Wedge Pressure Gate
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The Original Screw Lift Gate

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WITH THE WATER COMPANIES

Of Interest Expressly to Water Works Engineers, Superintendents and General Managers

WATER WORKS MEN ENJOY CONVENTION AT SANTA CRUZ

SAN DIEGO will be the meeting place of the 1926 convention of the California Section of the American Water Works Association, it was decided by that organization at its sixth annual convention, held in Santa Cruz during October. The section accepted the cordial invitation from San Diego as presented by A. P. Lovell, superintendent of the San Diego Water Department.

The convention next year will have to be a record-breaker in every way, however, it was agreed by the water works men, if it is to excell the 1925 session. An attendance of 247 interested delegates, coming from all parts of the state, combined with an excellent program of practical papers and delightful entertainment, made the recent convention a most successful gathering from every viewpoint.

NEW OFFICERS elected for the coming year were:

Chairman: C. B. Jackson, superintendent, Fresno City Water Corporation, Fresno. Mr. Jackson was vice-chairman in 1925 and has been active in the affairs of the Section. He succeeds as head of the organization George W. Pracey, superintendent of the Spring Valley Water Company, San Francisco, who retires from the official board of the Section after six years of service.

Vice-chairman: S. B. Morris, superintendent and chief engineer, Water Department, Pasadena. Mr. Morris becomes vice-chairman after three years of efficient service as secretary, in which capacity he was largely responsible for the helpful and well-balanced program of technical papers delivered at Santa Cruz.

Secretary-treasurer: Paul E. Magestadt, designing engineer, East Bay Water Company, Oakland.

Members of Executive Committee: John Burt, manager, Marin Municipal Water District, San Rafael; and P. Diederich, superintendent, Department of Public Service, Glendale. Both of these members were re-elected to their positions on the executive committee.

A feature of the convention was the presentation *"in absentia"*, of the Nicholas S. Hill cup, an annual award offered by a former president of the American Water Works Association to that regional section which has shown, during the year, the greatest growth in membership. Fred M. Randlett, National Director of the American Water Works Association, attended the convention for the purpose of presenting this trophy to the California Section, but the cup had been mysteriously mislaid in transit, and when every effort to locate it failed, Mr. Randlett made a graceful presentation speech, congratulating the Section upon its growth, and urging the organization to still further expansion, and awarding the cup as a recognition of the 1925 record—although no cup was at hand.

The report of the secretary revealed the growth recorded during the year upon the basis of which the cup was awarded. Twenty-eight members were added to the Section, of which twenty-two were active, two corporate, and four associate members, bringing the total membership of the organization to 125.

In the course of his remarks Mr. Randlett told the delegates of the activities of the national organization and made special reference to the new publication of the Association, a volume of value to all water-works men, entitled "Manual of Water Works Practice".

THE OPENING day of the convention was devoted largely to preliminary speeches and reports, followed by an informal dinner in the evening. The morning session was a general get-together of delegates, devoted to registration and an inspection of the exhibits which had been prepared by the associate members of the organization. At the afternoon business session, Arnold Williams, city engineer of Santa Cruz, the hostess city, delivered a paper on "Recent Improvements in the Santa Cruz Water System," which was followed by two symposium discussions on "Service Installation Methods and Standards" and "Meter Maintenance Records". The first of these discussions was opened by A. P. Lovell, superintendent of water, San Diego; and the second by G. E. Sedgwick, district manager of the Pacific Gas & Electric Company at Dixon, California.

In these discussions and in all the symposia included on the program one very noticeable feature was the freedom with which the delegates participated in informal and extemporaneous discussion, exchanging experiences and comparing notes without restraint. A factor contributing to this desirable spirit was the free-and-easy manner of the presiding officer, President George W. Pracy, whose native wit and platform ability put every delegate at ease.

THE SECOND day of the convention was "strictly business". One of the most instructive papers of the day was that of I. E. Flaa, chief draughtsman of the Spring Valley Water Company, San Francisco, on "Design and Construction of Concrete-Lined Distribution Reservoirs." This paper was followed by a treatment of "Design of Balancing Reservoirs and Stand-Pipes for Flat Cities and Communities," by E. K. Barnum, engineer, Fresno City Water Corporation. S. B. Morris, superintendent and chief engineer of the Pasadena Water Department, read a paper on "Seismic Activity in Santa Barbara", prepared by V. E. Trace, superintendent of the Santa Barbara Water Department. The morning session was concluded by a symposium led by J. I. Prugh, superintendent of distribution of the Sacramento Water Department, and participated in by fifteen other members.

The afternoon session included the following papers: "Relation of Railroad Commission to the Water Works Man", by W. R. MacKall, hydraulic engineer, California State Railroad Commission; "Co-operation Between Water Works and Fire Departments in Decreasing Losses," by Thomas Baird, chief engineer Fresno Fire Department; and "Adjustments", by Frank F. Clark, chief adjuster, Spring Valley Water

Company, San Francisco. Four short papers were read in concluding the meeting, as follows:

"Methods used in moving 36-inch Riveted Steel Water Main," Judy I. Prugh, superintendent of distribution, Sacramento Water Department; "Relation of Water Pressures, Service Sizes and Interior Fixtures to Complaints of Inadequate Water Service," V. E. Perry, assistant manager of water sales, Spring Valley Water Company, San Francisco; "Methods of Protecting Services and Meters during Street Grading and Paving Operations," P. Diederich, superintendent Public Service, Glendale; and "Use of Mechanical Equipment in Trenching, Backfilling and Pipe Laying", by Thomas Brooks, assistant superintendent of the Bureau of Water Works and Supply, Los Angeles.

On Friday evening the members of the section and their guests were entertained by the exhibitors at an informal dinner-dance at the Hotel Casa Del Rey, convention headquarters. On Saturday, the Chamber of Commerce and city of Santa Cruz conveyed the delegates and their guests on a motor trip through the city, where a new water distribution reservoir was inspected, and along the famous Cliff Drive. Luncheon was served at the Country Club at Aptos. In the afternoon the drive was completed via the Big Trees, stopping en route to inspect the pressure filter and pumping plant of Santa Cruz.

San Diego Approves Purchase of San Dieguito System

A bond issue for the purchase of the San Dieguito water system was approved at the polls by the voters of San Diego, California, almost unanimously during October. The vote recorded at the election was 11,711 in favor of the proposition to 997 against it. The bond issue authorized by this election will consist of $500,000, constituting the initial payment on the San Dieguito system, which will cost the city a total of $3,750,000

By the deal the city will take over the Lake Hodges system, another dam site above Lake Hodges, water bearing land in San Pasqual valley and the Sutherland damsite. The developed properties are to give the city a net safe yield of from 12,000,000 to 15,000,000 gallons a day.

It is planned that the city will take over the system on Dec. 1, and thereafter will receipt for moneys for water sold ranchers and other consumers not in the city. The city also will save $3,000 a month that is being paid the company for water served La Jolla and the bay shore communities from the Lake Hodges system.

Honolulu to Issue Million Dollars in Bonds for Water

The issuance of bonds to the amount of $1,000,000 by the city and county of Honolulu, Hawaii, has been authorized by President Coolidge on the recommendation of Secretary Work.

Proceeds from the sale of the bonds are to be used in the improvement of the water supply and sewage system of the city and county. The outstanding indebtedness of the city and county is $2,080,000 and this amount together with the proposed issue of $1,000,000, aggregating $3,080,000, is within the maximum legal limit of indebtedness, which is $6,420,000. Records show that the real and personal property of the city and county of Honolulu as assessed is the sum of $214,275,164.

Fresno Fair Shows How It Can Be Done

(Continued from Page 19)

Leaders of the irrigation equipment industry have repeatedly called attention to the fact that the displays afforded at Sacramento are not commensurate with the primal importance of irrigation to the entire state.

Those who have attempted to secure better exhibit facilities for irrigation at the Sacramento Fair have pointed out that agriculture is the fundamental basis of the organization, and behind practicaly all agriculture in California is irrigation; and that, in spite of steadily increasing expenditures for horse-show pavilions, grandstands and similar needs, the irrigation display—such as it is—continues to be housed in a tent, far removed from the center of things, with no adequate plans or facilities for a representative exhibit.

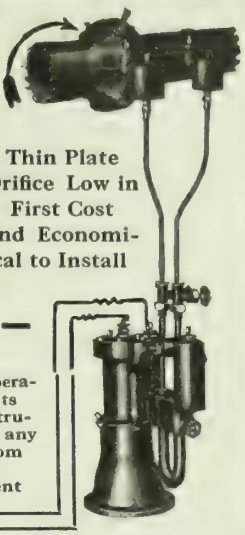
Manufacturers and dealers are hopeful that the success achieved by the Fresno fair in giving irrigation a "square shake" may inspire the management of the State Fair in California to provide for an irrigation display on a larger scale and to appropriate the necessary funds for the construction of a pit and other necessary facilities.

Fresno has led the way for bigger and better irrigation exhibits in every state, county or district fair in the entire west.

This Month's Cover

The picture appearing on the cover of this month's issue of MODERN IRRIGATION shows a crew of workmen engaged in laying a thirty-six inch riveted steel siphon on the Vista Irrigation District, California. Construction activities in this district are described in detail in an article beginning on Page 13.

Thin Plate Orifice Low in First Cost and Economical to Install



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150,000,000 G.P.D. for Atlanta.
60,000,000 G.P.D. for Sacramento
25,000,000 G.P.D. for San Francisco.
55,000,000 G.P.D. for Lindsay-Strathmore Irrigation District.
26,000,000 G.P.D. for Washington State Soldiers' Settlement.

De Laval Pumps were installed as above because they are the most efficient, the finest design and construction, of perfect reliability, and ALWAYS THE BEST.

Modern Irrigation Managers cannot afford to use anything else than De Lavals, the pumps that are built to operate cheaply instead of merely to sell cheaply.

Any pumping job freely and gladly estimated.

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WHO'S *WHO* AND WHO'S *WHERE*

IN IRRIGATION AND RECLAMATION

Personal Notes and Impersonal Observations About Men You Know

S. L. Rothery, office engineer for the Imperial Irrigation district, has resigned his position and on November 1 became associated with Vaughn Wood in private engineering practice in Los Angeles.

Andrew Weiss, assistant director of reclamation economics, and W. W. Johnson, have completed a survey of the irrigable lands of Jefferson County, Oregon, and have rendered their report to the commissioners of the County.

W. R. Elliott, consulting engineer of the Gila Valley (Arizona) Irrigation District, was in Safford, Arizona, early in October, for a conference with irrigationists of that section on the proposed construction of a storage dam for the Safford valley.

Arthur S. Bent, prominent construction engineer and contractor, recently resigned his post as a member of the Board of Education of his home city, Los Angeles, after two years service. He is succeeded by Clair L. Peck, also a construction engineer.

L. M. Holt, of Yakima, Washington, superintendent of the Indian Irrigation Service in that district, recently made a ten day trip of inspection over the projects under his jurisdiction. Good crops and generally favorable conditions were reported on all of the projects which he visited.

T. O. Walton, director of the Texas agricultural extension service, has been made president of the Agricultural and Mechanical College of Texas and is succeeded as extension director by Charles H. Alvord. Mr. Walton has been connected with extension activities in Texas since 1909 and was director of the service, comprising some 330 workers, from July 1, 1921.

Several Southern Pacific officials, including Guy Shoup, general counsel; Sam Andrews, land appraiser and B. A. McAllister, commissioner for the Southern Pacific Land Company, were in the Imperial Valley during October for conferences with directors of the Imperial Irrigation District on problems connected with the Mexican lands of the district.

Professor Frank Adams, of the University of California, will be in charge of the program devoted to water conservation and flood control at the Seattle meeting of the western division of the Chamber of Commerce of the United States, to be held December 7 and 8. Prof. Adams is head of the department of irrigation investigations and practice at the state university.

George Curry, international boundary commissioner for the United States, recently visited the Rio Grande Valley to co-operate with officials of the San Benito Water District in making a survey of the Rio Grande River from Roma to the mouth. An army flier has been assigned to the survey to assist in giving accurate information which will assist the district in planning for flood control and irrigation.

A committee of irrigationists from Pasco, Washington, representing the Pasco Chamber of Commerce, recently carried to Erle J. Barnes, State Commissioner of Conservation and Development, at White Bluffs, their plea for immediate consideration of an engineering report on the proposed development of the Snake River for irrigation. The committee included F. L. Perry, C. F. Stimson, H. P. Vermilye and E. J. Raynolds.

Robert B. Van Horn, formerly maintenance engineer on the Tieton division, Yakima project, recently resigned to accept a position as instructor in the engineering department of the University of Washington. His place on the project has been filled by the transfer from the storage division of Tom C. Mead. H. Ellis Sealing, senior draftsman, who has been engaged on the topographic surveys on the Kittitas division, has beeen transferred to Yakima to fill Mr. Mead's place.

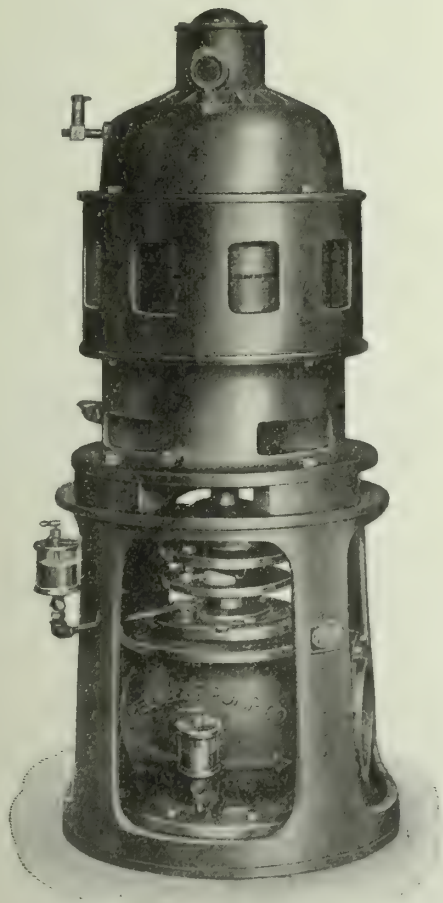
Joe E. King, district manager of the Southern Sierras Power Company, addressed the Imperial Valley Farm Lands Conference at El Centro early in November. The subject of his remarks was: "The Part Hydroelectric Interests Play in the Development of Farm Real Estate." He pointed out that every fourth ranch home in California has an electrical distribution system, and indicated that it is electricity that is largely responsible for holding up agricultural production in the face of a constantly decreasing farm population.

W. L. Powers, of the Oregon Experiment Station, Charles P. Shaw of the California Experiment Station, and Macy H. Lapham of the United States Department of Agriculture, have recently completed a study of the lower Klamath Lake region of southern Oregon and northern California. The report was not especially favorable, and mentioned several important drawbacks existing in this region, including much peat land, some concentrations of black alkali, and the tendency of crops to exhaust quickly the plant food in the soil.

Professor Charles H. West, assistant agricultural economist in the experiment station of the University of California, recently addressed the joint meeting of the Irrigation and Agricultural Sections of the Commonwealth Club of San Francisco on the subject of the condition of agriculture in the irrigated districts of California. Professor West pointed out that the farmer should receive fair prices for his products before irrigated lands should be further expanded. He presented figures showing that the irrigated area of the state had increased from 4,200,000 acres in 1919 to 4,700,000 acres in 1924.

Peerless Performance

The acid test of any piece of machinery comes when it is subjected to continued service and is *thoroughly tried* and *tested* by experienced engineers.



Peerless Pump performance is absolutely guaranteed. We welcome the most thorough investigation of our product *before* it is installed, and the most rigid tests *after* installation, as we want every Peerless Pump to be absolutely satisfactory to its owner.

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Fruitvale Mutual Water Co.	San Jacinto, Cal. (6)
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Beaumont Irrigation Co.	Beaumont, Cal. (3)
Covina Irrigating Co.	Covina, Cal. (4)
Louis Didier	Puente, Cal. (2)
Wilson & Moore Ranch Co.	Lancaster, Cal. (2)
Santa Paula Water Works	Santa Paula, Cal. (2)
Patrick Farrell	Chino, Cal (2)
Chowchilla Colonization Co.	Chowchilla, Cal. (2)
City of Inglewood	Inglewood, Cal. (3)
R. M. Wright	Santa Susanna, Cal.
Mt. Antonio Water Co.	Claremont, Cal.
Valley View Water Co.	Claremont, Cal.
Thermal Belt Water Co.	Santa Paula, Cal.
Limited Mutual Water Co.	Ontario, Cal.

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For Detailed Listings, Branch Offices, Etc., See the Buyers' Guide to Leading Supply Sources—Pages 55-56

RECLAMATION

A 1925 REVIEW OF GOVERNMENT RECLAMATION*

THE POLICY of reclaiming arid and semiarid lands by the Federal Government came into existence with the passage of the reclamation act in 1902. To date the Government has spent $200,000,000 on works to irrigate more than 2,000,000 acres of land which support almost a half million people.

It was believed that if the Government built dams and canals agriculture would follow; that settlers would take up the lands and carry out the costly and difficult task of clearing off the sagebrush, leveling the surface, providing farm buildings, implements, and livestock, and doing all those things that are necessary to change the desert into productive farms.

The Government made generous terms for the repayment of the cost of the works. The settlers were to pay annually the cost of operating and maintaining the dams and canals. The cost of construction was to be repaid to the Government at first in 10 annual installments, which was later increased to 20 annual installments. These liberal terms of payment for a water right—20 years without interest—made this domain a fruitful field for the land speculator and the result was a rapid and disastrous inflation of prices on land in private ownership.

MORE than two-thirds of the lands under works constructed by the government were privately owned when construction started. The political prestates frequently determined the location of many of the projects. As a result canals were built to water unfit land and where the cost of development was more than agriculture could stand. A survey recently conducted by a fact-finding committee on Federal reclamation showed that an amount estimated at $26,000,000 had been expended for the irrigation of worthless and unfertile lands, much of which had been abandoned by settlers.

Designed as a home-making institution, Federal reclamation as carried out in the past has been defective. There was no selection of settlers based on experience and qualification, and the opinion prevailed that the reclamation act did not permit the employment of people to give practical advice on the preparation of the land for cultivation or instruct the beginner, to whom conditions were new, as to what crops to plant and when to plant them. The Reclamation Service was primarily a construction agency with the social and human requirements omitted from its administration.

The consequence was that some of the land was acquired by people who had never been farmers and never expected to be, while the real farmer, who took his family into this new domain with his money and experience, had a faith and confidence in the Government that it would not have spent immense sums to build these irrigation works unless it was to create conditions under which he could make a living.

SETTLERS who entered on these projects under the impression that they were obtaining a farm practically free of cost found that it cost thousands of dollars to do the preparatory work. Lacking the capital themselves, there was no credit agency from which they could obtain money on terms suited to the undertaking. They could only borrow on short-time payments and at high interest rates. Eight and twelve per cent is being paid on many projects for money borrowed to level the land, build homes, and buy implements and livestock.

When he tried and failed, the settler's faith in our institutions was weakened, and a succession of such failures has eliminated blame from the individual and fastened it onto the system or conditions under which he attempted to create a home. Instead of being the open door to farm ownership, many of these Government projects have been the scene of heart-breaking experiences to settlers and their families, leading to failure and loss of their land and lifetime savings. There are at the present time 6,000 unoccupied farms of varying size on Government projects.

The financial difficulties of irrigation farmers led to a practice of not paying the Government for the service it rendered in providing water, because postponement of that payment did not increase the debt, which bore no interest. Congress was also appealed to repeatedly and laws were passed authorizing deferred payments or giving blanket relief to all water users on a project. Under these moratoriums delinquent payments on operation and maintenance were added to construction costs. These measures gave no permanent relief to the struggling settler who had met his payments. They often did enable the well-to-do landowner to avoid making his payments.

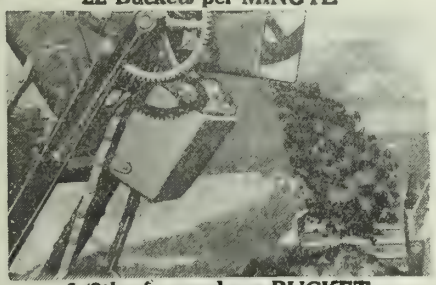
THE SURVEY of the fact finders showed that only one of the projects had met its obligations as they fell due, and in addition to the failure to pay construction costs about 33 1-3 per cent, or approximately $5,688,000, of operation and maintenance costs, payable annually, remained unpaid, including $1,060,000 current costs not yet assessed against the water users and $1,194,000 operation and maintenance charges to be repaid as construction.

Two years ago a program was inaugurated for the reconstruction of the Federal reclamation policy. A change in the law was enacted by Congress a year ago to provide for a different method of repayment of construction charges to the Government. Instead of paying an arbitrary amount annually based on 20-year installments regardless of the productivity of the irrigation farms, provision is made for payments of a percentage of the gross value of the crops produced. The percentage was fixed at 5 per cent of a 10-year average. The question of eliminating from the

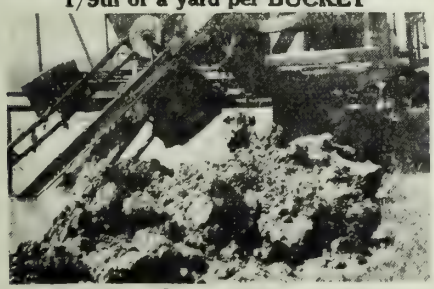
*This article is reprinted from a report of the U. S. Department of the Interior, issued during October, entitled "A 1925 Review of the Department of the Interior."

There is no CHEAPER WAY to CLEAN or DIG a CANAL than the RUTH WAY

22 Buckets per MINUTE



1/9th of a yard per BUCKET



1,500 yards per 10-hour DAY.

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	10 Hrs.
DIGGING CAP., 2½ cu. yds. per min....	1,500
CLEANING (one side)	
Low gear (lineal feet).....	3,800
Second gear (lineal feet).....	5,850
High gear (lineal feet).....	9,150
FUEL COST	
Gasoline .....19 gals. @ 23c	$4.35
Oil .....4½ qts. @ 40c	1.80
Grease .....6 lbs. @ 10c	.60
OPERATING COST	
One Operator @ 80c.....	8.00
One Helper @ 50c.....	5.00

CONSIDER. A machine moving practically a continuous flow of dirt. A continuous line of digging, shaving, cutting buckets; filling and ejecting twenty-two buckets a minute of dry earth, adobe or clay. In water, taking with every cut, small willows, tules, water grass and all other small growths, along with a clean, shaving of the bank.

Each bucket filling and emptying clean, one-ninth of a cubic yard of dirt, every time around. In an average day, under average conditions, the Ruth cleans out 1,500 cubic yards of canal earth, leaving a clean cut, smooth faced bank. The capitulation below gives more detailed costs and capacities.

Truly, we claim that with the Ruth bucket and its Ruth Ejector, the Ruth Super Crawler Dredger is the only machine of its kind today, in its particular field of irrigation, reclamation and drainage ditching.

Why dig a ditch, then let it grow up with weeds, when the Ruth will keep it clean and in better shape than when new, at such a low cost?

Write us fully today of your irrigation, reclamation or drainage problems. We will help you.

Tell Us

How many miles of canals in operation or to be constructed?

Is it irrigation or drainage?

How many acres reclaimed or to be reclaimed?

In dry earth—in running water—at any slope, The Ruth automatically digs and cleans smooth even ditches.

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projects the immense areas of land unfit for cultivation was met through the classification of the soils on all the projects. This has not yet been completed, but recommendations are to be presented to Congress for reducing the size of projects containing infertile lands and allowing settlers occupying worthless farms to exchange them for productive ones. Most of the projects are now being operated by the Government, but the new reclamation law provides that the farmers through their own water users' association or irrigation districts may take over the operation of the projects.

THE ESSENTIAL part of the Federal reclamation policy of the future is a program of land settlement and farm development. Unless settlers can be attracted to the projects and are able to remain on them, there is no reason for building them, and the Government will not be reimbursed for their costs. The Government can construct irrigation projects, but it can not draft settlers. One solution of the settlement problem is cooperation between the Federal Government and the States in which projects are located, the States to assume the responsibility of settlement. In authorizing appropriations for the construction of several new projects and additions to old projects last year Congress inserted a provision in the law for the first time stipulating that the States shall settle them.

Any new settlement policy must be based on the selection of settlers who have had experience in farming and who have sufficient capital to underwrite advances made by the Government. Financial aid to settlers at a low rate of interest for the clearing of the land, improvement of the farms, and purchase of necessary equipment is also paramount to success. Until these problems of land settlement and farm development of the old projects can be solved the consensus of opinion is that the construction of new works should be deferred. The first intention of reclamation was to build homes. Ownership of homes by the settlers on the old projects should be assured before new projects involving the expenditure of additional millions are attempted. Securing settlers is of all reclamation problems the most difficult.

Protecting Our Irrigated Lands From Alkali

(Continued from Page 15)

To apply the exact amount of water necessary to meet the needs of crops without some passing below the zone of plant growth and being wasted is impractical if not impossible. Even to approach this ideal practice in irrigation requires a knowledge of the depth of root systems of plants and also the water holding capacities of different soils. These are all factors which may vary greatly, even within a small area. The result is that more water is applied, ordinarily, than is necessary to meet actual crop needs.

The history of irrigation throughout the arid west is that large quantities of water are wasted into the soil. On practically every large area that has been under irrigation for any considerable time, the water table has risen sufficiently to threaten the irrigability of the soils. On most of them portions of the lands have been rendered unfit for cultivation, through excess water and alkali accumulations, until drained and protected by artificial means. On many small areas, where natural drainage conditions are exceptionally favorable, artificial works are not necessary. In a few localities where natural surface supplies have been supplemented by pumping underground water the rise in the water table has thus been prevented. Numerous examples of this sort are to be found in Southern California. In the Salt River Valley of Arizona wells which were sunk primarily for the purpose of lowering the water table and protecting soils from seepage and alkali have served also to supplement the surface water supply during dry periods.

THE CHARACTER of works that have been found necessary to lower and control ground water in irrigated lands varies considerably to suit the local conditions of the area involved. Generally it may be said that such works differ also in some respects from drainage works intended to remove surface waters in humid areas. These differences are due partly to fundamental differences in the soils of humid and of arid regions; but principally to the fact that, in the one case ground waters, and in the other, surface waters, are to be removed.

The removal of ground waters involves consideration of sub-surface or subsoil conditions. The methods employed must be suited to the particular formation to be dealt with, and are subject to considerable variations in different areas. The minimum depth to which ground water must be maintained in order to afford protection against alkali concentrations must be considered. This depends primarily upon the capillary

power of the particular soil, or, in other words, upon the height to which water will be lifted in it by capillary action.

It is gratifying to note that the question of protecting soils through drainage and other irrigation is being regarded more and more as an essential part of irrigation farming. During the past ten years many millions of dollars have been invested in drainage improvements over the irrigated areas of the west.

The financial backers of irrigation enterprises generally realize that protection of soils is necessary in order to make the lands safe security for investments.

Settlers Needed on Newlands Irrigation Project

The Newlands irrigation project, Nevada, of the Bureau of Reclamation, Department of the Interior, was started in 1906, and irrigated agriculture was practiced on the river bottom lands for more than a generation previous, yet only about half the lands are now in crop. Most of the canals and other structures necessary for irrigating all the useable lands have been completed and are ready for use. These investments must be paid for, and to do so it seems highly desirable that every effort be made to attract new settlers to the project.

This conclusion is reached by Charles F. Shaw, Professor of Soil Technology of the University of California, who has completed recently a review of land classification on the Newlands project. The work of classifying the lands was performed by a local cooperative committee of farmers and covered the lands of the Truckee-Carson Irrigation District, an organization of farmers. The lands of the district and of the project are practically the same, except for proposed additions to the project under the Spanish Springs extension.

The lands were classified into six classes. Productive lands are in classes 1 to 4, temporarily unproductive lands in class 5, and permanently unproductive lands in class 6. The lands in class 6 comprise 32,313 acres, nearly all of which had been eliminated prior to the classification. The irrigable area, covered by classes 1 to 5, comprise 74,605 acres. Of the irrigable lands within the district only 61,607 acres are now under water-right contracts.

Drainage is naturally poor over much of the district. An extensive drainage system is planned and partly constructed by the Bureau of Reclamation under contract with the district, the latter assuming all responsibility for care and maintenance.

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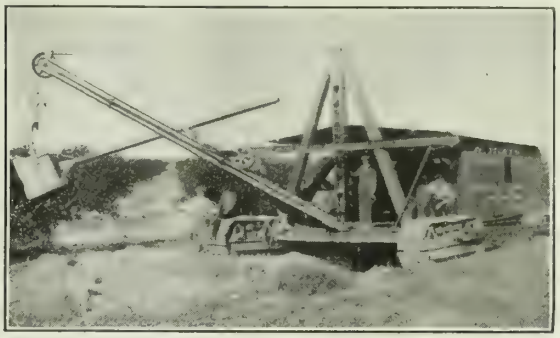

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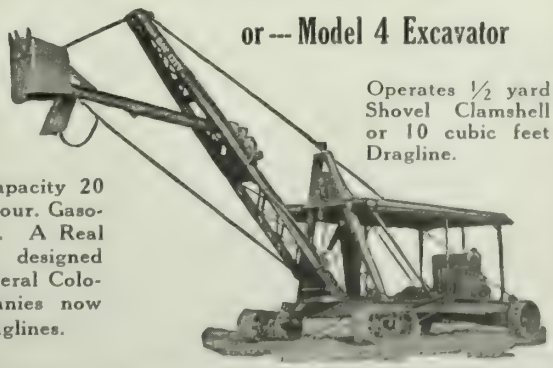

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IRRIGATION FINANCE

WHAT OREGON NEEDS—AS THE BOND-BUYER SEES IT

By JOHN DWIGHT NEALE*

SOME years ago the state of Wyoming issued about two and one-half million drainage district bonds throughout the Big Horn Basin irrigated area. Depression in agriculture came along and the districts in that region found themselves hard pressed to pay principal and interest on the bonds. The state legislature passed a law providing for the refunding of these securities into low-rate, long-term bonds, and also a law providing for the purchase of such refunded drainage bonds by the state of Wyoming. This has been done in practically all districts, and all parties interested are benefited.

OREGON statesmen have said much about high-interest rates which irrigation districts have had to pay; the large discounts irrigation bonds carried; how great a burden this was to Oregon farmers and how money has been wasted in construction costs. I believe much of this is literally true. I also believe that the means for relief from this situation and the avoidance of its recurrence are within Oregon's grasp.

Oregon has a law authorizing the certification of its irrigation district bonds. She also has a law permitting the state payment of interest on irrigation district bonds for a 5 year period.

She also has an intelligent group of men vitally interested in irrigation development, who have organized the Oregon Irrigation Congress, which feels the urge and necessity of spending three days in annual convention, determining ways and means of furthering the cause of irrigation and increasing the population, wealth and production of Oregon. Oregon's representatives in the Federal Congress have been outstanding advocates of irrigation development in the west, in general and in Oregon in particular.

Irrigation districts have organized and issued bonds in the amount of about $13,000,000. All of these things, therefore, lead me to believe that Oregon is interested in irrigating her arid land, in enlarging and conserving the credit of her irrigation securities and in placing Oregon in a position to care for her full share of new immigration and Pacific Basin commerce and trade.

GRANTING that these things are true, therefore, why not clinch the nail on the other side? Why not *settle* the land within the irrigation districts for which water is now available?

Why not forget that the western one-third of Oregon needs less irrigation than the eastern two-thirds, and instead of making of irrigation a political or sectional question make of it a state wide subject of deepest interest, of equal importance with state highways, educational institutions and all other major state policies?

Oregon must make some arrangement for settling her lands, for which water is now available.

She cannot today readily sell new irrigation district bonds. I know of three Oregon irrigation districts which now have bonds for sale and for which Oregon or California bond dealers will make no reasonable offer.

Why bid on new issues when blocks of bonds of those districts which have their systems all completed are floating around in the open market and offered almost daily at prices below that which the districts received for them? Investors and bond dealers think something has happened to Oregon irrigation district bonds. What is the result?

BOND dealers buy bonds to sell—not to keep. They cannot stay in business and buy what they cannot sell. It will be considerable time before Oregon can enter the money market and sell her irrigation district bonds readily. This will be a good thing for those districts already created and with land available for settlement, provided Oregon business men, bankers, chambers of commerce and this Congress get down to the business of settlement of lands already available under completed systems.

Settlement of these lands will weed out the unfit and the large land owner, and will encourage the farmer who has been striving to use well his land and water. For the next five years, at least, Oregon's irrigation work is one of settlement—not the creation of new districts nor obtaining of appropriations from the U. S. R. S.

Oregon can make her irrigation district credit worth 100 cents on the dollar by keeping her irrigation management out of politics and by formulating a definite land settlement and land development policy, just as she has of her state highways and harbors.

She can save her own credit, and her farmers millions of dollars in interest, by providing immediate legislation for refunding all her outstanding irrigation district bonds and by issuing, in lieu thereof, state bonds bearing 3½ or 4 per cent interest instead of 6 per cent.

She can discourage and hold in check local communities desirous of bringing new irrigation districts into existence until those already created and having outstanding certified irrigation district bonds are settled and made a definite asset to the state.

She can establish a central state agency for the listing of all land within existing irrigation districts which is for sale, or which can be acquired from the districts for taxes, and thus have available a central clearing house for disposing of all such land to homeseekers. Such a plan would co-ordinate and correllate state wide interests and action in the matter of land settlement within irrigated areas. Willamette Valley itself would produce twice as much, on the average, if it had three four-inch irrigations in the height of the growing season, during the usual period of summer drought. Thus, a statewide interest—

* This article is taken from a paper delivered by the author before the fifteenth annual meeting of the Oregon Irrigation Congress.

a Willamette Valley interest, if you please—could be created in Oregon irrigation.

Another advantage of this plan and program would be the elimination of extravagant statements and representations by land-selling enthusiasts of the various local communities. This central state agency, acting as a clearing house for all irrigated land which is open for settlement, or which may be secured for taxes, would publish all the literature describing the same and this literature would be primarily to state facts rather than sell land in any particular locality.

THIS is a plan for land settlement which is worthy of careful analysis, and which must be followed, in the main, by all western states which have more irrigated land available than present owners can use profitably.

A few years of intelligent application of this plan and principle would settle up all Oregon irrigation districts now created. It would make their bonds worth 100 cents on the dollar. It would place every Oregonian back of irrigation development in Oregon. It would complete the program initiated when reclamation of Oregon's arid and semi-arid lands was commenced, on a large scale, 20 years ago. It would permit the formation of only such irrigation districts as have merit and which could be settled and works built at a cost within economic reason.

As your system now stands, your state engineer and your bond commission are placed in a hard and unreasonable position. They have little real authority about holding back ill-timed or questionable development. They see districts already created with large unsettled and unused areas, yet are asked to approve and certify new districts and their bonds where settlement will be necessary and where construction costs are uncertain.

A definite state-wide program of land settlement must be placed in operation before the credit of Oregon irrigation district bonds is restored and before new issues will sell readily in the open money market.

Notwithstanding Oregon's long past history of fine achievement and development, her highest and best attainments are yet to be realized.

So long as an alert and awakened conscience, on the part of each Oregonian places full value upon the part capital and credit play in developing and rendering useful to millions, your vast natural resources, so long will Oregon continue to take her proper place as one of the great commonwealths of the nation.

Permissible Canal Velocities

(Continued from Page 33)

terial is much greater than the velocity required to maintain movement of particles of that same material before becoming bedded or that have been raveled off by higher velocities than the bed would stand.

4—Colloids in either the material of the canal bed or the water conveyed by it, or in both, tend to cement particles of clay, silt, sand, and gravel in such a way as to resist erosive effects.

5—The grading of material running from fine to coarse coupled with the adhesion between particles brought about by colloids makes possible high mean velocities without any appreciable scouring effect.

6—Irrigation canals may be designed for the velocity that is permissible when seasoned by age, as the demand for water grows with the age of the canal and the maximum mean velocity grows with the supply necessary to satisfy this demand.

7—Power canals are likely to be placed under peak load as soon as feasible after completion. For this reason a more conservative velocity should be chosen, otherwise scour may take place before seasoning.

8—Canals, when new, may be operated with velocities less than the maximum permissible, by the use of check structures.

9—A slight excess of velocity is preferable to insufficient velocity. Check-drop structures will correct a slope causing erosion, but there is no method within reasonable cost by which velocities may be increased.

10—In the past, engineers have been led astray by too close an adherence to the results of experimental data on the transporting action of water on such materials as clay, silt, sand and gravel, considered separately rather than on cohesive or mechanical combinations, and in consequence many canals have been designed and built on too flat slopes with correspondingly low velocities.

11—The growth of aquatic plants is but partially connected with velocities. Canals designed for the highest permissible velocities, from the standpoint of erosion, will be as free from plant growth as design alone can effect.

Execute Bond Sale Contract

Officials of the Palo Verde (California) Irrigation District in October closed final details and executed the contract for the sale of $1,863,000 in bonds issued by the district. The entire first and second issues, totalling $3,500,000, are now being printed in Los Angeles.

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A Constructive Program of Irrigation for Oregon

(Continued from Page 16)

sections of the State where development work is most needed;

"That a representative committee be appointed to study, report and make recommendations for the proper use of group credit, settlement, repayment, power development, and related reclamation legislation, to be reported at the next session of the Oregon Reclamation Congress;

"That a study should also be made of possible improvement of the Irrigation District Law;

"That irrigation district directors be urged to employ colonization managers to work in cooperation with the Land Settlement Departments of the Chambers of Commerce for the settlement of all lands in the districts;

"That neither law, constitutional authority, nor appropriation of funds renders possible the assumption of settlement of Federal reclamation projects by the State."

Other resolutions endorsed the work done by the Portland Chamber of Commerce with the Oregon Development Fund, the work done by the Experiment Station on the Relation of Electricity to Agriculture, and disapproved public development of electric power.

Hood River was selected as the place for holding the annual meeting of the Reclamation Congress next year.

A SETTLEMENT program for filling up unoccupied farm units on Oregon projects is being developed by the organization along the following lines: It is proposed to list unimproved or excess holdings for sale within a reasonable time at a price to be fixed by impartial appraisers. Information for prospective settlers should be based on an agricultural economic survey of the project and approved by the experiment station authorities. Only settlers of suitable capital, experience and industry should be considered. Each project should have a colonization manager to work in cooperation with the Land Settlement committees of the Chambers of Commerce in securing and locating settlers. A project agricultural advisor, where the work can not be handled by the county agriculturist, should be provided under the supervision of the Extension Service. Each project should have a revolving fund with which to fit and seed a portion of each vacant tract in perennial meadows such as alfalfa. On new projects excess land should be contracted for sale at a minimum price and any increase in the "going" price of unimproved land within a reasonable time should be divided equally with the districts, to be used in the improvement of idle tracts coming into the ownership of the district.

The general situation of the irrigation farmer in Oregon today is greatly improved. Delegates to the recent Irrigation Congress were driven over projects in the Rogue River Valley, where the value of the crop this year will practically equal the cost of the water rights per acre. The Talent Irrigation District with a bond issue of $1,100,000, will produce this year a crop worth $1,000,000. The value of crops on the Medford Irrigation District will be approximately $2,000,000. On the Grants Pass Irrigation District some small farmers took from $400 to $800 an acre of crops in berries or apples. One harvested 5,400 pounds of snap beans from an acre in time to net 6 cents a pound. One farmer, Charles Brooks, near Grants Pass, took $860 from three-fourths of an acre of strawberries. The gross crop value from irrigation projects in the Rogue River Valley this season will run approximately $5,000,000, or an average gross value per acre amounting to more than half of the cost of the water rights.

Service Installation Standards

(Continued from Page 22)

this method the consumer is given a better supply and the Department has one less pipe to maintain in the street. Also, the domestic service can be enlarged by unscrewing the bushing in this tee.

We have specifications covering curb cocks, galvanized iron street elbows, couplings and elbows from ½ to 2-inch. The reason for this standardization is not alone to insure good composition, galvanizing, weights, etc.; it is also to insure a standard dimension so that when a fitting has to be renewed, the space for the meter remains the same.

A special two-inch bronze angle valve is now being used and takes the place of a regular curbcock on account of the fact that the keys corrode in the bodies of the curb cocks, making it very difficult and precarious at times to operate them. This angle valve has a female thread for riser and a male thread for the meter flange. It takes the place of a street elbow, curb cock and short nipple.

We are now contemplating the use of copper pipe for sewer connections instead of the regular galvanized iron or steel, which corrodes very rapidly in certain soils and conditions.

MODERN Irrigation

Have You a Delegate at This Meeting?

THE COMPETITIVE business world of today moves forward on two wheels. One of these is salesmanship proper and the other—*advertising.* Whether you realize it or not, business amounting to billions is now transacted annually through the advertising pages of magazines and industrial publications. It is *here* that the preliminary skirmish of competition takes place and many a silent victory is won, or nearly won, before the salesman calls.

The advertising pages of MODERN IRRIGATION are a market-place. Here, once each month, is held a sales convention on paper. Here representatives of the leading equipment manufacturers speak their messages to the great market that buys your products.

These "silent salesmen" are an indispensable part of the general campaign; as necessary in their way as is the personal representative who stands between you and your customers, and your prospective customers. Do not, like the fabled ostrich, hide your head in the sand and imagine otherwise. You may, by cultivating such an illusion, go on saving the cost of a monthly advertisement; but if that is your policy you are slowly and certainly losing prestige, business and good will—of a far greater value to you—and making it easy for the more astute competitor, who does not believe in such limitation of armaments, to penetrate your market, overcome advantages which you hold in fancied security, and eventually outflank you on this important sector.

At this moment, the pages of MODERN IRRIGATION are being examined, and examined carefully, by men whose yearly purchases in your line aggregate large sums of money. Long-pull advertising will help you to secure a larger percentage of this annual turn-over. The men who buy are reading and studying these advertisements—never doubt it. Consciously, or unconsciously, they are forming their opinions and narrowing down their ultimate choice of equipment. Many *actual decisions* are made months in advance of the order for the goods. None but the most backward companies in business today are not fully alive to this, while those of seasoned advertising experience are now, as never before, bringing up their advertising artillery for the big year's business ahead.

There will be no disarmament in the business world the coming year—no unpreparedness in the organizations of progressive business concerns. Competition will be keener than ever before. The personal skirmishes and "bouts" of your salesmen and distributors in the field will have their counterpart in the drive for business and prestige through the advertising pages. Laggards and sluggards will drop out, and fall by the wayside. Live, up-and-going companies will go forward on "both wheels."

Think the matter over. The monthly meeting on these pages will go right on, month after month, and the silent but efficient emissaries of the leading companies in your line will be present. Your own advertisement gives you representation according to your merits. Why not decide upon a campaign now, and let us talk the subject over with you?

We'll be glad to introduce your "Silent Delegate" at the next monthly meeting.

For Detailed Listings, Branch Offices, Etc., See the Buyers' Guide to Leading Supply Sources—Pages 55-56

OVERHEAD IRRIGATION

OVERHEAD EQUIPMENT MUST BE CAREFULLY SELECTED

By J. P. CAMPBELL*

MODERN growers who are interested in overhead irrigation are also interested in ascertaining what equipment will give them the best results and the largest returns upon their investment. The following is a brief outline of what many years of practical experience has demonstrated to be the most satisfactory.

Hillside irrigation with overhead sprinklers on the Leo V. Youngworth ranch, near Culver City, California. On close inspection the hundreds of sprinklers are visible.

Pipe is the largest item of expense in an overhead system. It is not only subject to dampness in the soil and changes in temperature, but in many cases chemical conditions of the soil tend to make it very short lived unless it is of the best quality and proper precautions are taken to protect it.

In order to obtain the maximum length of service nothing but full weight standard pipe should be used for the underground main and lateral supply pipe and sprinkler stands, in the writer's opinion. Laterals that are too small to be properly dipped both inside and out should be galvanized, but the larger sizes will last as long or longer if properly dipped with hot asphaltum.

Where it is necessary to reduce initial cost of intallation a good heavyweight casing or line pipe, or even riveted pipe can be used for the larger mains. If of good quality and properly protected these materials will give years of good service and, in case of deterioration or damage, can then readily be replaced or repaired, but I regard it as the height of folly to use lightweight high-carbon casing or boiler tubes for laterals and stand pipes. On a properly installed system there usually is more than a thousand feet of lateral pipe to the acre and one may readily imagine the endless annoyance and expense of replacing and repairing when this thin material begins to rust through and leak, which it will probably do after a few months of service.

Pipe used should always be large enough to carry thirty to fifty per cent more water than is necessary properly to operate the sprinklers it supplies. This is necessary on account of the constantly decreasing inside diameter, which condition is much more pronounced on low pressure systems or where water containing certain minerals is used.

As to fittings, when these are obtainable it is preferable to use cast iron instead of light malleable on the underground system. Even black cast iron fittings, painted on the outside last practically a lifetime, I have found. Standard 125-pound brass gate valves should be used for controls on the underground system.

Sprinklers are by far the most important item to be considered in connection with the modern overhead system. They should be simply constructed, long lived, give a uniform distribution in small rain-like drops so that all the water will fall to the ground and "soak in" and not be lost by evaporation. They should also have the smallest possible delivery capacity so as to prevent washing or puddling, this being especially essential on heavy soils and steep hillside installations. After testing practically every sprinkler manufactured including more than fifty experimental devices personally designed, the writer has found the small high-speed type with round delivery openings

Another view of the same ranch. This scene is on top of the hill shown in the upper picture. The trees are young avocados, to which overhead irrigation is particularly applicable.

*Mr. Campbell is president of the J. P. Campbell Irrigation Company, Los Angeles.

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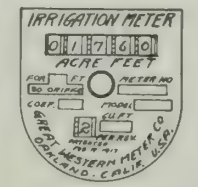

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that delivers about three gallons per minute and covers an area up to sixty feet in diameter, by far the most economical and satisfactory.

When used for orchard irrigation this sprinkler is placed at alternate trees in alternate rows (one to each four trees) and when used for vegetables or other small crops forty-five to fifty feet apart and staggered so that each sprinkler will be exactly in the center and equidistant from the six sprinklers surrounding it.

UNDER certain conditions, especially where water is cheap and delivered under a high pressure, properly designed, larger coverage sprinklers can be used. I do not believe it is possible, however, to secure the uniform distribution obtainable with the smaller radius sprinklers, and the loss from evaporation is much higher. Many are of the opinion that the larger coverage a sprinkler has the lower the cost of installation but there is very little difference if high-grade pipe and other material is used.

In order that each sprinkler may deliver the same quantity of water, it is absolutely necessary that a stop cock or valve be used on each sprinkler stand; otherwise, even on perfectly level installation, the sprinklers nearest to supply would deliver much more than those farther away on the line and on hillside installations those on the lower levels, where the least water is required, would give more than those on the higher levels. Furthermore, in some instances it is necessary to have these cocks or valves in order to cut down the pressure so that the delivery will be in drops instead of a spray.

If the water supply comes from an open reservoir or other source containing moss or other matter, a strainer of sufficient capacity to handle the maximum amount of water used without friction loss should be installed at the source of supply. All pipe, no matter how clean it may be when first installed, will eventually begin to disintegrate and give off more or less scale on the inside; so it is vitally necessary that a strainer be used with each stand-pipe. In this connection I will call attention to the combination regulating valve and strainer now on the market, which usually is placed about twelve inches above ground level. This device also has a dirt trap which can be cleaned from time to time as necessary and is especially valuable in connection with sprinklers used for orchard irrigation, avoiding the necessity of either taking down the stand-pipe or using a ladder to clean scale or other matter out of the sprinklers. The writer regards this combination valve and strainer as vitally essential to an up-to-date installation.

The Power Behind the Pump

(Continued from Page 19)

ranging from 10 inches to 36 inches in diameter.

The wells are equipped with Layne & Bowler turbine pumps driven by Westinghouse Vertical Motors, with a total of 325 H. P. The water from these wells is delivered to a reservoir at the main booster plant. The booster plant lifts the water 156 feet through a 28-inch steel line to the higher level by means of three Byron-Jackson centrifugal pumps, direct connected to Westinghouse motors, a total of 425 H. P. Float switches are installed to open the no-voltage release circuit before the water drops to a level in the reservoir that might cause the pumps to break suction and operate dry.

In this main booster plant is located the switchboard, an example of the latest design. In place of using knife switches with fuses, oil circuit breakers are used with overload protection for each motor. Among other features are the recording voltmeter, giving a chart of the voltage at all times, as well as service interruptions. Ammeters are installed in each motor circuit to give the current load, and as a warning of mechanical troubles that might occur to the pumps.

In the upper zone there are two additional booster plants. Plant No. 4 has a maximum lift of 113 feet, and is equipped with two Byron-Jackson centrifugal pumps direct connected to two Westinghouse motors with a total of 115 H. P. Plant No. 5 has a maximum lift of 70 feet and is equipped with two centrifugal Byron-Jackson pumps direct connected to two Westinghouse motors, with a total of 90 H. P.

SWITCHBOARDS in plants No. 4 and No. 5 are of the same type and construction as those at the main booster plant. These plants are being equipped with pressure gauges to shut off the power, should the water fail at either suction or discharge.

Power is supplied by the Southern California Edison Co., over a 15,000-volt line, and is stepped down to 440 volts through suitable transformers, located at the three plants. At the main booster plant, drawing the largest load, three 200-Kva. type "SK" single phase, Westinghouse transformers are installed. At Zone No. 1, the Edison rate P-1 is in force, based on maximum demand instead of connected load. Zone No. 2 is operated on the P-11 schedule which is a better rate where the pumps lie idle for any considerable period of time.

The first water was pumped through the lines in July, 1923, and the plants have since been in continuous operation without interruption.

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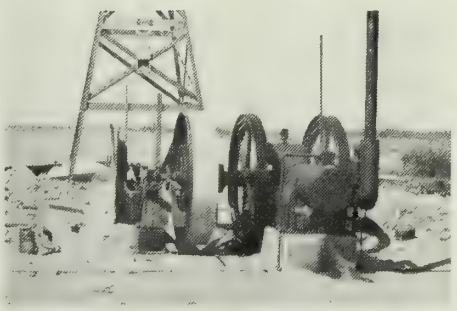

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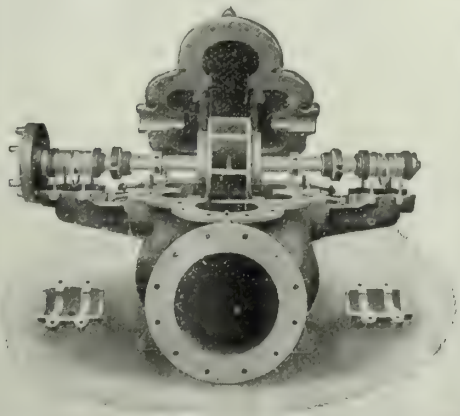

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SURVEY *of* IRRIGATION DEVELOPMENT

As Shown by Official Records of the Month -- Local, State, and Governmental

RECORDS SHOW WATER IS INCREASINGLY IN DEMAND

PERMITS to appropriate water issued in California by the Department of Public Works, Division of Water Rights, during the month of September, include the following:

Permit No. 2220, Application No. 4479 (Los Angeles County)—Issued to Frank P. Raggio, and Chester Smith, Saugus, Cal., September 3, 1925, for 1.12 cubic feet per second from San Francisco Creek, in Sec. 23, T 5 N, R 16 W, for domestic and irrigation use on 90 acres near point of diversion. Estimated cost $3000.00.

Permit No. 2222, Application No. 4492 (Los Angeles County)—Issued to Eugene M. Frazier, Los Angeles, September 4, 1925, for 0.37 cubic foot per second from a well in Sec. 22, T 5 N, R 16 W, for irrigation of 30 acres in Sec. 22. Estimated cost $2000.

Permit No. 2226, Application No. 4339 (San Diego County)—Issued to Lakeside Irrigation District, Lakeside, Calif., September 8, 1925, for 1 cubic foot per second from Los Coches Creek in Sec. 19, T 15 S, R 1 E, for domestic use and irrigation of 324 acres in said district. Estimated cost $10,000.00.

Permit No. 2227, Application No. 4364 (Yolo County)—Issued to W. S. Kendall, Sacramento, September 8, 1925, for 7.25 cubic feet per second from Sacramento River in Sec. 13, T 11 N, R 2 E, for irrigation of 581.8 acres near point of diversion. Estimated cost $8000.00.

Permit No. 2228, Application No. 4356 (Tehama County)—Issued to F. L. Jolly, Jolly, Calif., September 8, 1925, for 0.99 cubic feet per second from Sacramento River in Sec. 3, T 28 N, R 3 W, for irrigation of 79.5 acres near point of diversion. Estimated cost $5000.

Permit No. 2229, Application No. 4342 (Napa County)—Issued to Chas. A. Davis, Rutherford, Calif., September 10, 1925, for 0.5 cubic foot per second from Napa River in Sec. 15, T 7 N, R 5 W, for irrigation of 40 acres near point of diversion. Estimated cost $2000.00.

Permit No. 2230, Application No. 4347 (Los Angeles County)—Issued to Arthur D. Gookins, Roosevelt, Calif., September 10, 1925, for 0.35 cubic foot per second from Richardson Canyon No. 617 and Cow Spring Canyon in Secs. 1 and 2, T 7 N, R 17 W, for domestic and irrigation purposes on 30 acres near point of diversion. Estimated cost $5000.00.

Permit No. 2232, Application No. 4597 (Placer County)—Issued to Ethel May Mulligan, Lincoln, Calif., September 15, 1925, for 0.56 cubic foot per second from Auburn, Calif., in Sec. 9, T 12 N, R 7 E, for irrigation of 45 acres near point of diversion. Estimated cost $2500.00.

Permit No. 2234, Application No. 4345 (Placer County)—Issued to John W. Swanson, Auburn, Calif., September 16, 1925, for 0.25 cubic foot per second from an unnamed ravine in Sec. 27, T 14 N, R 9 E, for irrigation of 35 acres in Sec. 27. Estimated cost $1000.00.

Permit No. 2235, Application No. 4213 (Siskiyou County)—Issued to Antone S. de Avilla, Gottville, Calif., September 16, 1925, for 2.06 cubic feet per second from Beaver Creek in Sec. 19, T 47 N, R 8 W, for irrigation of 165 acres in Secs. 5 and 6.

Permit No. 2239, Application No. 4431 (San Joaquin County)—Issued to Elda Slack, San Francisco, Calif., September 19, 1925, for 3.38 cubic feet per second from Old River in Sec. 31, T 1 S, R 5 E, for irrigation of 270.8 acres near point of diversion. Estimated cost $4000.00.

Permit No. 2241, Application No. 4399 (San Joaquin County)—Issued to John Ohm, Vernalis, Calif., September 21, 1925, for 13.19 cubic feet per second from San Joaquin River in Sec. 13, T 3 S, R 6 E, for irrigation of 1055.3 acres near point of diversion. Estimated cost $14,000.00.

Permit No. 2242, Application No. 4429 (San Joaquin County)—Issued to Mrs. A. Banta, San Francisco, Calif., September 21, 1925, for 3.19 cubic feet per second from Old River in Sec. 31, T 1 S, R 5 E, for irrigation of 271.7 acres near point of diversion. Estimated cost $4150.00.

Permit No. 2243, Application No. 4432 (San Joaquin County)—Issued to M. J. Lund, Stockton, Calif., September 21, 1925, for 16.13 cubic feet per second from Old River and Grant Line Canal in Secs. 16, 20, 21, 28, T 1 S, R 4 E, for irrigation of 1290.5 acres near point of diversion. Estimated cost $9000.00.

Permit No. 2244, Application No. 4452 (San Joaquin County)—Issued to L. A. Bixler et al, Stockton, Calif., September 21, 1925, for 32.15 cubic feet per second from Grant Line Canal and Midale River in Secs. 29 and 6, T 1 S, R 5 E, for irrigation of 2572.4 acres near points of diversion. Estimated cost $63,000.

Permit No. 2245, Application No. 4472 (San Joaquin County)—Issued to M. Rossi, Stockton, Calif., September 22, 1925, for 2.46 cubic feet per second from San Joaquin River in Sec. 10, T 2 S, R 6 E, for irrigation of 196.6 acres near point of diversion. Estimated cost $3,500.00.

Permit No. 2246, Application No. 4506 (San Joaquin County)—Issued to Harry C. Finck, Stockton, Calif., September 22, 1925, for 3.92 cubic feet per second from San Joaquin River in Sec. 16, T 2 S, R 6 E, for irrigation of 313.4 acres near point of diversion. Estimated cost $8000.

Permit No. 2247, Application No. 4512 (San Joaquin County)—Issued to Wm. C. Ferguson, Stockton, Calif., September 22, 1925, for 5.79 cubic feet per second from Grant Line Canal in Section 25, T 1 S, R 4 E, for irrigation of 463.1 acres near point of diversion. Estimated cost $16.000.00.

Permit No. 2248, Application No. 4513 (San Joaquin County)—Issued to Wm. Ferguson et al, Stockton, Calif., September 22, 1925, for 12.72 cubic feet per second from Grant Line Canal in Section 25, T 1 S, R 4 E, for irrigation of 1017.3 acres near point of diversion. Estimated cost $16,000.00.

Permit No. 2249, Application No. 4383 (Los Angeles County)—Issued to R. P. Shea, Los Angeles, September 23, 1925, for 0.02 cubic feet per second and 10 acre feet per annum from Indian Springs and flood waters in Section 17, T 7 N, R 14 W, for domestic and stock watering purposes in Sec. 17. Estimated cost $10,000.00.

Permit No. 2252, Application No. 4451 (San Joaquin County)—Issued to Lewis Moreing, Sacramento, Calif., September 25, 1925, for 4.25 cubic feet per second from San Joaquin River in Sec. 4, T 2 S, R 6 E, for irrigation of 339.8 acres near point of diversion. Estimated cost $17,000.00.

Permit No. 2253, Application No. 4470 (San Joaquin County)—Issued to Lewis Moreing, Sacramento, Calif., September 25, 1925, for 14.14 cubic feet per second from San Joaquin River in Sec. 16, T 2 S, R 6 E, M.D.M. for irrigation of 1131 acres near point of diversion. Estimated cost $34,000.

Permit No. 2254, Application No. 4471 (San Joaquin County)—Issued to Moreing Brothers, Stockton, Calif., September 25, 1925, for 7.83 cubic feet per second from San Joaquin River in Sec. 27, T 2 N, R 5 E, for irrigation of 626.7 acres near point of diversion. Estimated cost $14,000.00.

Permit No. 2255, Application No. 4237 (Stanislaus County)—Issued to Patterson Ranch Co., Patterson, Calif., September 29, 1925, for 27.36 cubic feet per second from San Joaquin River in Sec. 22, T 5 S, R 8 E, for irrigation of 2189.29 acres near point of diversion. Estimated cost $35,000.00.

Permit No. 2257, Application No. 4165 (Siskiyou County)—Issued to E. C. and Kate C. Hart, Montague, Calif., September 30, 1925, for 600 acre feet per annum from Little Shasta River in Sec. 19, T 45 N, R 4 W, for irrigation of 1724.6 acres near point of diversion. Estimated cost $9200.00.

Applications Filed

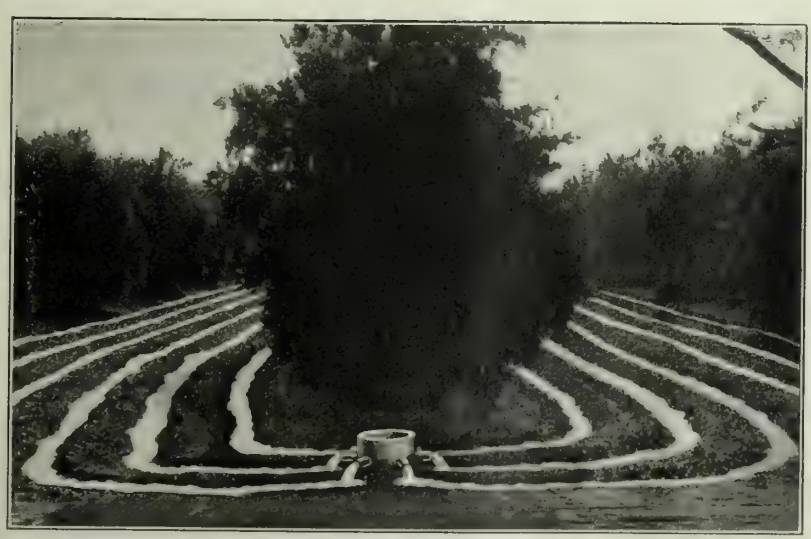
Among the applications for permit to appropriate water received by the Department of Public Works, Division of Water Rights of California, during the month of September, are the following:

Application No. 4759 (Los Angeles County)—Grace Oster Kamp, care Seaboard Engineering Co., Douglas Bldg., Los Angeles, for 0.6 cubic foot per second from an unnamed spring tributary to Triunfo Creek to be diverted in Section 7, T 1 S, R 18 W, S. B. M., to be used for irrigation and domestic purposes. Estimated cost $5000.00.

·SNOW·

IRRIGATION APPLIANCES

SNOW NO. 2 UNDER-ARCH ORCHARD VALVE



Water controlled with Orchard Valves and Galvanized Distributing Gates. In the orchard illustrated the furrows are 330 feet long. Note the thorough irrigation and uniformity and thrift of the trees.

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Application No. 4760 (Placer County)—Fred Dewhirst, trustee, care E. Emerson, Hoar Co., 995 Market St., San Francisco, for 300 cubic feet per second and 100,000 acre feet per annum from Bear River, tributary to Feather River, to be diverted in Section 2, T 13 N, R 8 E, M.D.M. for agricultural and domestic purposes on 60,000 acres in T 12 N, R 5-6-7 E and T 13 N, R 5-6-7 E, M.D.M.

Application No. 4761 (San Bernardino County, California) (Yuma and Mohave Counties, Arizona)—City of Los Angeles and Board of Water and Power Commissioners, care W. B. Mathews, 609 Public Service Bldg., Los Angeles, for 15,000 cubic feet per second and 600,000 acre feet per annum from Colorado River, tributary to Gulf of California, to be diverted in Section 2, T 1 N, R 26 E, S.B.M. for generation of hydro-electric energy in Section 2, T 1 N, R 26 E, S.B.M. 255,682 T.H.P. to be developed

Application No. 4766 (San Joaquin County)—California Land & Finance Co., care Ohm & Raab, 517 E. Market Street, Stockton, Calif., for 21.2 cubic feet per second from Fourteen Mile Slough tributary to San Joaquin River, to be diverted in (1) Sec. 24, T 2 N, R 5 E, (2) Sec. 30, T 2 N, R 6 E, (3) Sec. 29, T 2 N, R 6 E, M.D.M. for irrigation of 1702.2 acres, Sections 24 and 25, T 2 N, R 5 E, M.D.M. and Sections 19, 20, 21, 29, 30, T 2 N, R 6 E, M.D.M. Estimated cost $33,600.00.

Application No. 4768 (Amador & Calaveras Counties)—East Bay Municipal Utility District, 505 17th St., Oakland, California, for 375 cubic feet per second and 217,000 acre feet per annum from Mokelumne River, tributary to San Joaquin River, to be diverted in Section 26, T 5 N, R 10 E, M.D.M. for generation of hydro-electric energy in Section 26, T 5 N, R 10 E, M.D.M. 14,925 TH.P. to be developed. Estimated cost, $6,000,000.00.

Application No. 4769 (Calaveras County)—D. Fricot, Angels Camp, Calaveras Co., California, for 500 acre feet per annum from San Antonio Creek, tributary to South Fork of Calaveras River, to be diverted in Section 9, T 4 N, R 14 E, M.D.M. for irrigation and domestic purposes on 550 acres in Sections 27 and 28, T 4 N, R 13 E, M.D.M. and Sec. 36, T 4 N, R 12 E, M.D.M. Estimated cost $10,000.

Application No. 4770 (Calaveras County)—D. Fricot, Angels Camp, Calaveras Co., Calif., for 500 acre feet per annum from San Antonio Creek, tributary to South Fork Calaveras River, to be diverted in Section 9, T 4 N, R 14 E, M. D. M. for generation of hydro-electric energy in Section 27, T 4 N, R 13 E, M.D.M. 62 T.H.P. to be developed. Estimated cost $10,000.

Application No. 4771 (Alpine County)—Alhambra Mining Corporation, care J. W. Hopkins, Manager, Gardnerville, Nevada, for 7.5 cubic feet per second and 500 acre feet per annum from Crater Lake, tributary to West Fork Carson River, to be diverted in Sec. 11, T 10 N, R 18 E, M.D.M. for generation of hydro-electric energy in Sec. 11, T 10 N, R 18 E, M.D.M. 213 T.H.P. to be developed.

Application No. 4773 (Los Angeles County)—Nannie S. Biddison, Saugus, Calif., for .08 cubic foot per second from Biddison Spring, tributary to Santa Clara River Watershed, to be diverted in Sec. 22, T 6 N, R 14 W, S.B.M. for domestic and irrigation purposes in Section 22, T 6 N, R 14 W, S.B.M.

Application No. 4788 (Lake and Mendocino Counties)—Snow Mountain Water and Power Company, care Max Thelan, Balfour Bldg., San Francisco, for 400 cubic feet per second and 214,813 acre feet per annum from South Eel River, to be diverted in Section 14, T 18 N, R 10 W, M.D.M. and Section 30, T 18 N, R 11 W, M.D.M. for generation of hydro-electric energy at plants (1) Sec. 14, T 18 N, R 10 W, (2) Sec. 6, T 17 N, R 10 W (3) Lot 96, Yokaye Rancho —43,226 T.H.P. to be developed. Estimated cost $6,954,910.00.

OREGON

The following applications for permit to appropriate water have been filed in the office of Rhea Luper, State Engineer of Oregon:

Wilbur Broughton of Hebo, covering the appropriation of water from Deep Creek for irrigation of 36 acres and domestic purposes in Tillamook County, at a cost of $1,500.

Paul Schuttpelz of Lakeside, covering the appropriation of water from Hall Creek for domestic supply for city of Lakeside, Oregon, in Coos County, at a cost of $3,000.

Central Pacific Railway Company of San Francisco, California, covering the appropriation of water from Cascade Creek, and also from South Fork of Salt Creek for railroad and domestic supply in Lane County, Oregon, at a cost of $4,800.

Thomas J. Tyrrell of Unity, covering the construction of the Tyrell Reservoir for storage of 70-acre feet from Burnt River Watershed for irrigation purposes in Baker County, at a cost of $1,800.

W. A. Wagner and K. S. Francis of Enterprise, covering the appropriation of water from Hurricane Creek and two springs for irrigation of 144.5 acres in Wallowa County.

William W. Brown and Bertha M. Forbes of Stauffer, covering the appropriation of water from Benjamin Lake for irrigation of 380 acres in Lake County.

F. S. Morrison of Halfway, covering the appropriation of waste water and slough water from certain lands irrigated from Clear Creek for supplemental irrigation of 40 acres in Baker County.

W. G. Scott and Chas. P. Nelson of Portland, covering the appropriation of water from a small stream or branch for municipal purposes for Nelscott Beach, in Lincoln County, at a cost of $1,000.

Power Developments

The Federal Power Commission, in October, authorized issuance of licenses and permits, including the following:

Project No. 137—To J. W. Preston, Jr., of San Francisco, a license for 50 years for a power project designated as "Salt Springs Unit" located on the North Fork of the Mokelumne River partly within the El Dorado and Stanislaus National Forests, in Amador and Calaveras Counties, California. The project will consist of a rock-fill dam approximately 200 feet high and 960 feet long, and a conduit about 25 miles in length to convey the water from the reservoir created by the dam to a power house, designed to have an installed capacity of about 42,000 horsepower. The power generated will be used in the Pacific Gas & Electric Company's power system. This project is a part of a comprehensive scheme for the development of the river.

Project No. 338—To the Nevada Irrigation District, a municipal organization with headquarters at Grass Valley, Nevada County, California, license for 50 years for storage and diversion of water from Middle Yuba River and Canyon Creek (a tributary of South Yuba River) for combined power development and irrigation use. The project involves diversion from the Middle Yuba at the Milton dam site through a tunnel 4 miles in length to Bowman Reservoir in Canyon Creek. The regulated supply from this reservoir and another up-stream at French Lake will be carried by conduit about 11 miles to the rim of Spaulding Reservoir on the South Yuba. The water will then be conducted through the Spaulding power plant of the Pacific Gas & Electric Company, a part of the discharged water going through the South Yuba canal and Deer Creek plant to the upper lands of the District and the remainder through the Drum Canal and power plant to Bear River for diversion to the lower lands. The estimated installed capacity of the project is 150,000 horsepower.

Project No. 492—To J. E. Walker, of Mackay, Idaho, a license for 50 years for a power project on Big Boulder Creek partly within the Challis National Forest, in Custer County, Idaho. The project will develop approximately 153 horsepower to be used in mining operations.

Project No. 529—To the Oregon-California Hydro-Electric Company, of Portland, Oregon, a preliminary permit for two years for a power project on Zigzag, Salmon, and Sandy Rivers, in Clackamas County, Oregon. The project consists of diversion dams, a storage dam, conduits, and a power house. The estimated power capacity of the project is 23,000 horsepower, and the installed capacity, 70,000 horsepower.

Project No. 570—To the Appleton Land, Water & Power Company, of Los Angeles, California, a preliminary permit for two years for a proposed power development within the Santa Barbara National Forest on Deep Creek, a tributary of Mohave River, in San Bernardino County, California. The project consists of a storage dam designed to create about 1,000 acre feet of storage, with about three miles of water conduit, and a power house having an approximate installed capacity of 7,900 horsepower. The power generated will be used primarily for irrigation pumping.

Project No. 588—To the Northwest Power & Light Company, of San Francisco, California, a preliminary permit for two years for a power development in the Elwha River, Clallam County, Washington. The project will consist of a concrete dam with an adjacent power house developing about 160 feet in head in Glines Canyon. The reservoir formed by the dam will impound about 15,000 acre feet of water. The power capacity of the project is about 7,900 horsepower.

Project No. 619—To the Feather River Power Company, of San Francisco, California, a license for 50 years for a power project on Bucks, Grizzly, and Milk Ranch Creeks, tributaries of the North Fork of Feather River, in Plumas County, California. The project consists of a dam in Bucks Creek 106 feet high creating a reservoir with approximately 103,000 acre feet of storage, diversion dams, and conduits, tunnels and penstocks leading to a power house on the North Fork of Feather River a quarter mile below the mouth of Bucks Creek. The power house will have an installed capacity of 60,000 horsepower. The power generated will be used in the power system of the Great Western Power Company.

New Incorporations

No. 116050—SNOW CANYON MUTUAL WATER COMPANY, (a California company). Directors: N L Levering, Redlands; L. G. Levering, Redlands; E. C. Gird, Hollywood; W. H. Johnson, Redlands; Fred A. Wilson, San Bernardino; (each 1 share). Date of filing, Oct. 14, 1925. Place of business, Redlands. Capital stock, $15,000. Par value, $20. Amount subscribed $100. Purposes to furnish water to stockholders only at cost. Articles filed by Swing & Wilson, Garner Block, San Bernardino.

No. 116088—YALE MUTUAL WATER COMPANY, (a California company). Directors: W. P. Banes, L. G. Brubaker, B. A. Harbour, R. F. Guthrie, J. W. Hays, all of Hemet. Date of filing, Oct. 16, 1925. Place of business—Hemet. Capital stock, $15,000. Par value, $50. Purposes to furnish water to stockholders only, without profit to company for domestic and irrigation purposes, upon certain parcels of land in Lot One in block 110, subdivision of land of Hemet Land Company in Hemet, County of Riverside. Articles filed by Henry Goodcell, 306 Katz Bldg., San Bernardino.

No. 116126—SANTA RITA IRRIGATION COMPANY, (a California company). Directors: J. Leroy Nickel, Jr., San Francisco; Vincent J. McGovern, San Francisco; H. T. Gower, San Francisco; W. S. Mitchell, Alameda; W. H. Trump, San Anselmo, (each one share). Date of filing, Oct. 20, 1925. Capital stock, $20.000. Par value, $100. Amount subscribed, $500. Place of business, San Francisco. Purposes to supply and deliver water for irrigation and domestic uses to lands in the San Joaquin River water shed now owned by Miller & Lux, Inc. (a Nevada company). Articles filed by J. E. Woolley, 1128 Merchants Exchange Building, San Francisco.

No. 116150—COUNTRY CLUB PARK MUTUAL WATER COMPANY (a California company). Directors: Frank C. Nye, 24 shares; Xina Adair Nye, one share; J. R. Gabbert, all of Riverside, one share. Date of filing, Oct. 21, 1925. Place of business, Riverside. Capital stock, $3,900. Par value, $150. Amount subscribed, $3900. Purposes to purchase 26 shares of capital stock of Gage Canal Company and transfer one share of such stock to the owner of each lot in the Country Club Park and pipe water to said lots for the use of said owners on said lots. Articles filed by A. Arid Adair, 202 Loring Building, Riverside.

No. 116180—NORTH LONG BEACH EXTENSION WATER COMPANY (a California company). Directors: J. L. Bentley, Wm. Reed, T. R. Johnson, J. Kratzer, G. W. Wheatland, Long Beach. Date of filing, Oct. 23, 1925. Place of business, Long Beach. Capital stock, none. Purposes to take over the wells and water plants on Tracts 5992 and 6018 as per Maps of record in County Recorders office of Los Angeles County, and to furnish water to the owners of said tracts of land without profit, supply same at cost of maintaining said wells of water. Articles filed by L. D. Uhlman, 1225 Pacific-Southwest Bank Building, Long Beach.

Overhead System on 10 Acres

A ten-acre installation of sprinklers has been completed on the Henry Behrens citrus ranch, at Yorba Linda, in Southern California.

Concrete-Lined Reservoirs

(Continued from Page 18)

into three compartments, so arranged that either half of the ultimate 10,000,000 gallon reservoir can be operated independently of the other half. Two 24 inch cast iron pipes lead from the tower through a concrete culvert under the embankment to the mains in the street and one 12 inch cast iron drain pipe connects with the sewer.

BIDS WERE called for, the contractor to furnish labor and material, excepting the pipe, sluice gate, gate valves for the outlet works. These were to be furnished and installed by the owner. The owner also was to furnish and place the plastic material in the expansion joints. Three bids were received ranging from $62,400.00 to $70,200.00, and the lowest bidder got the job for $62,405.50.

A steam shovel was used for excavating and the material transported to the embankment by dump wagons where it was spread in four-inch layers wet down and rolled with a ten-ton roller. This excavation was carried to within two or four inches of the final grade, then trimmed to grade and made ready for the concrete lining; during the excavation, springs were encountered which were drained by a six-inch cast iron pipe along the toe of cut on the uphill side, thence under the division wall through the embankment on the downhill side. No further trouble was encountered from that source. After the floor and side slabs were poured the roof columns were erected by a derrick using a Ford truck for power which ran on the completed floor.

The contractor finished his work in three months. The owner then cleaned the expansion joints and placed the plastic material, which in this case was a patent compound—a combination of tar and asbestos filler.

DATA ON STANFORD HEIGHTS RESERVOIR

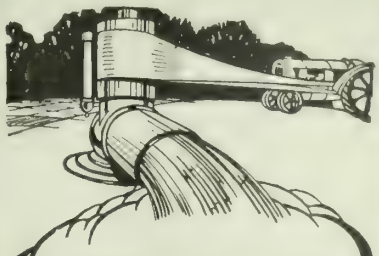
Capacity	5 M. G.
Total Cost	$68,725.86
Cost per M. G. storage	$13,745.00

Per Cent of Total Cost

Stripping	2.7
Excavation and fill	22.4
Trimming	2.7
Lining	31.9
Roof	18.7
Structures	8.6
Division Wall	9.9
Engineering	3.1
Total	100.0

Other Data

Time to complete	3 months
Kind of lining	6-inch exp. joints
Cost of lining per cu. yd.	$21.89
Cost of lining per sq. ft.	42c
Cost of sq. ft. of roof	27c



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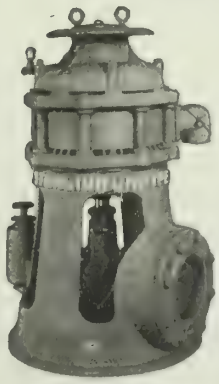

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AMONG OUR CONTRIBUTORS

Editorial Jottings About Current and Forthcoming Feature Articles, Dealing With Practical Problems of Hydraulics, and the Men Who Have Written Them

THE ENGINEER holds the place of honor in this issue of MODERN IRRIGATION. The interesting problems of construction met and overcome by the Vista Irrigation District are described by Kenneth Q. Volk, who is chief engineer in charge of the work about which he writes. The problems of alkaline soils are dealt with by D. W. Murphy, a consulting engineer recognized as an authority on drainage and underground water problems. Two prominent waterworks engineers are the authors of "The Design and Construction of Concrete-Lined Distributing Reservoris," and "Standards of Service Connection Installations."

Mr. Volk, who is a new contributor in this issue, is associated with J. B. Lippincott, one of the best known of California's consulting engineers. He has been engaged in irrigation engineering in the southwest for the past twelve years, having become connected with Mr. Lippincott's office soon after his graduation from the University of California as an irrigation engineer. For some time he was a resident engineer on the Santa Fe Irrigation District, and now holds that position on the Vista District.

DANIEL W. MURPHY, who discusses problems of alkalinity in this issue, is a graduate of Stanford University, having received the degrees of A. B., A. M. and Ph. D. from this institution. He also studied at the Physicalishe Reichsanstalt, in Charlottenburgh, Germany. From 1896 to 1900, he was Assistant Professor of Physics at Stanford University.

Mr. Murphy entered the United States Reclamation Service in 1904, and occupied successively the positions of Project Engineer of the Klamath Project in Oregon, Office Engineer in the Washington Office, and, from 1911 to 1918, Drainage Engineer. In the latter position, he was in charge of drainage work on all of the projects of the service, including fifteen projects throughout the west which required drainage.

Since leaving the Reclamation Service, in 1918, Mr. Murphy has been in private consulting practice in Los Angeles, specializing in irrigation, drainage and underground water problems. During this time, he has been connected with the largest and most important drainage projects in the southwest, including the drainage of the Salt River Valley, in Arizona, and the Palo Verde and Imperial Valleys, in California.

Mr. Murphy is co-author with F. H. Newell of "Principles of Irrigation Engineering," and author of "Drainage Engineering." His scholarly attainments, large and diversified practical experience, and sound engineering and business judgment, combine to make him a recognized authority on drainage and underground water problems.

WRITING on the subject of "A Constructive Irrigation Program for Oregon," W. L. Powers is able to speak as a representative of practically all hydraulic interests of that state. Mr. Powers was recently named secretary of the reborn Oregon Reclamation Congress (formerly the Oregon Irrigation Congress) and has been an active member of that organization since its inception in 1910; he has been secretary of the State Drainage Association since its formation ten years ago; and for ten years has been doing a very valuable work for the state and for irrigation, as Chief of the Division of Soils, at the Oregon Experiment Station, at Corvallis. The departments with which he is concerned are Soil and Soil Water, so that much of his work is with the practical problems of irrigation and drainage.

D. W. MURPHY
Consulting Engineer

Two other well-known names connected with irrigation research appear in this issue—Samuel Fortier and Fred C. Scobey. Neither requires introduction to an irrigation audience. Both are connected with the Berkeley Office of the Division of Agricultural Engineering of the Department of Agriculture, and have contributed much to the technology of the industry through their work. The article appearing under their names is an abridged presentation, which they have prepared for this magazine, of their paper, under the same title, published in full in the Proceedings of the American Society of Civil Engineers, of which they are members.

HUGH CRANE, author of the article describing the irrigation display at the Fresno Fair, is a staff contributor. I. E. Flaa is chief draughtsman of the Spring Valley Water Company, San Francisco. George Read, author of the paper presented on Page 22, is superintendent of the meter and service department of the Bureau of Water Works and Supply of the City of Los Angeles. The latter two articles are taken from papers presented at the October convention of the California Section of the American Water Works Association.

John Dwight Neale, who tells what Oregon irrigation needs from the standpoint of the security buyer, is known to MODERN IRRIGATION readers from previous contributions. He is identified with J. R. Mason & Company of San Francisco. J. P. Campbell is president of the J. P. Campbell Irrigation Company.

HOPE deferred maketh the heart sick, but in the case of B. J. Seger's good article on "Credit for Irrigation Projects—How to Establish and Maintain It," which was promised to our readers for this issue, an unavoidable postponement has been necessary which, it is to be hoped, will only serve to sharpen the appetite. Mr. Seger's discussion of irrigation's credit problems, with which he is intimately familiar, is in type, but other material, which would not permit of postponement to the December number, displaced it at the last minute. Mr. Seger's contribution will appear in December.

SEVERAL other features of special interest are due for presentation in the concluding number of Volume I of this magazine. A general survey of irrigation developments since 1918, by Thomas H. Means, San Francisco engineer, will appropriately close the calendar year. Everett M. Bryan, deputy chief of the Division of Water Rights of the California Department of Public Works, has written a vitally interesting article on "Importance of Orderly Establishment of Water Titles," a question of significant importance wherever irrigation is practiced. George M. Jewett, president of the Federal Land Bank at Spokane, Washington, has contributed a valuable discussion of an up-to-date phase of irrigation finance, under the title "Federal Farm Loans on Irrigated Lands." Irving C. Harris, Los Angeles Power Engineer, will write on the connection between irrigation and hydro-electric developments, bringing out some little-known data on this subject. Mr. Harris for five years had charge of the construction and operation of the power system and pumping plants on the Salt River project, in Arizona, and is thoroughly familiar with the hydro-electric side of irrigation work.

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For 12 Months: $2.00; Single Copies: 20 cents.

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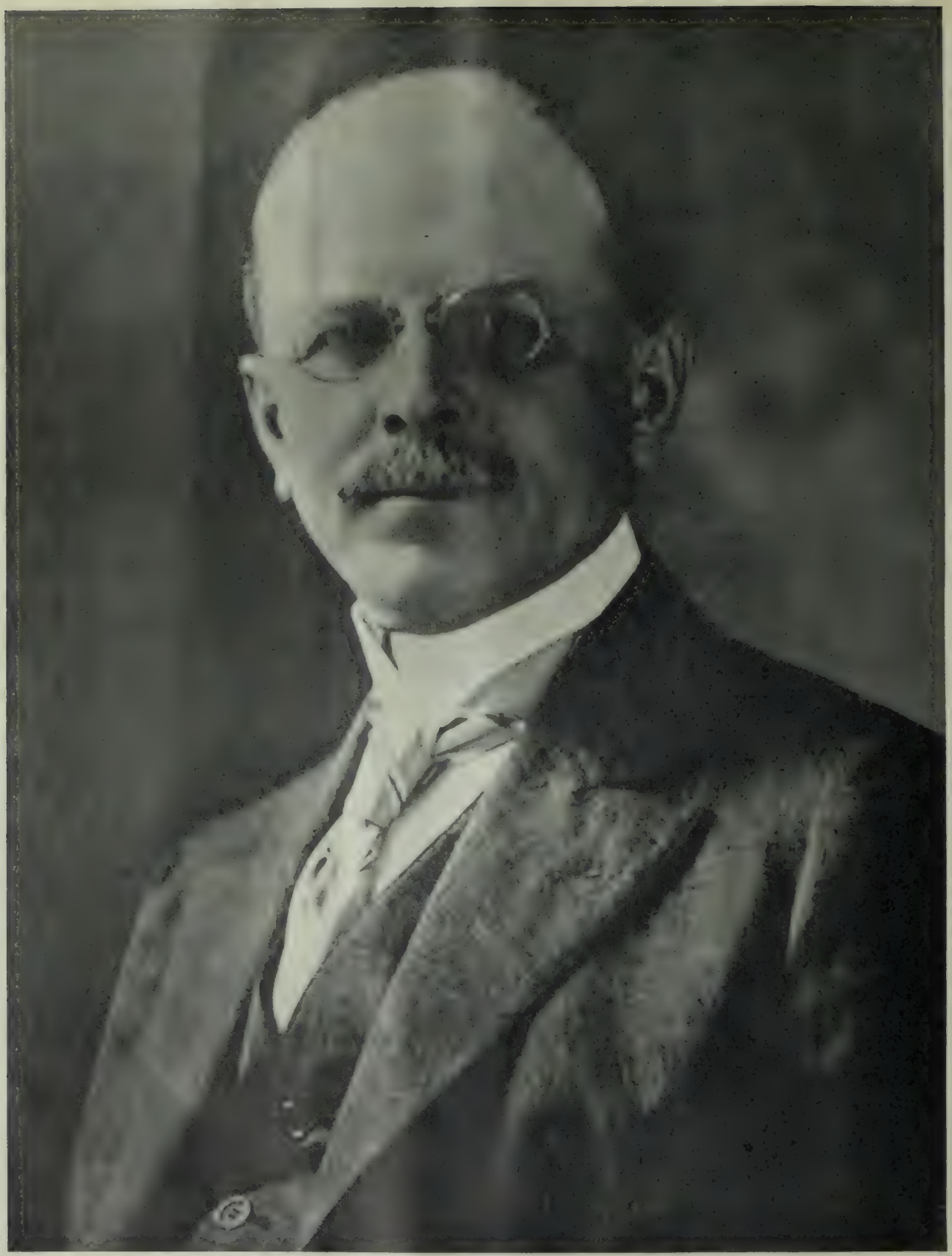
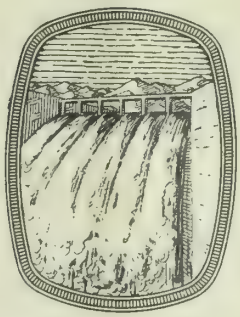


ADDISON T. SMITH

Representative in Congress from Idaho, and chairman of the House Committee on Irrigation and Reclamation. In an article in this issue Mr. Smith discusses, from the standpoint of the national legislature, some of the leading current problems of reclamation. He has seen reclamation's needs at first hand, having had an experience in the governmental treatment of such problems as an attorney, a land-office official, and as a Congressman since 1913, and is ably qualified to speak with authority on such matters.

MODERN Irrigation
The Magazine of Applied Hydraulics



Volume 1 DECEMBER, 1925 Number 6

The Progress *of* Irrigation

NINETEEN TWENTY-FIVE has been a year of preparation in the hydraulic and irrigation industries. As we review it in perspective, it seems apparent that this year must be classed with those significant periods in time which, of themselves, offer few highlights in sensational events, but which, nevertheless, are necessary for the gathering of the forces that ultimately flash across history's page in splendid attainments. Before every era of constructive achievement there must be some such period of transition: when determinations are forming, plans are crystallizing, differences are being harmonized, and social opinion is in a state of flux—from which it emerges with new strength to urge its servants forward to spectacular accomplishments.

Glancing around the world we see that irrigation has been making steady strides forward in other continents than our own, as is pointed out in a review of world developments in this issue. With the exception of California, where certain notable projects are going ahead quietly but steadily, America has lagged behind somewhat in the race, if her advance be measured by works actually undertaken and completed. And yet, when the final story is told, it will probably be said that 1925 was a year of real progress. New concepts have been forming, stock has been taken of the past, its errors and its successes, old theories have been scrapped and new ones formulated, and the way has been cleared for a faster, more direct, march forward in the future.

THIS CONDITION has been especially true, and indeed has been especially necessary, in those branches of hydraulic development where politics plays an important part. The irrigation industry has proved itself competent to handle, in most cases, the engineering and economic factors with which it must deal. Where political considerations enter it has been woefully unsuccessful.

In such typical cases as the developments undertaken in California by the Merced Irrigation District in the construction of the Exchequer Dam, and the East Bay Municipal Utilities District in reaching out to the Mokelumne River for new water supplies for domestic and irrigation use, the continued success and expansion of the Salt River project in Arizona, and other similar enterprises, able engineering direction and wise finan-

cial planning, freed from political interference, are recording a steady progress. On the other hand, the disputes surrounding government reclamation policies in Idaho and Oregon, the Colorado River impasse, in which state and national politics are hopelessly entangled, the Kittitas project, the Columbia Basin project in Washington, and the dissension which divides the Imperial Irrigation District, present admirable examples of the destructive influence of the political element.

IRRIGATION is learning, as other big business has long since learned, to beware of unnecessary political interference. Many reclamation developments are undoubtedly the proper function of the federal government, but conservative judgment dictates that neither federal support, nor state aid, nor legislative panaceas of whatever kind, may be relied upon to make irrigation, or hydro-engineering enterprises of whatever character, a success.

As the sixty-ninth Congress convenes, therefore, the industry looks to it with interest, but without much hope. Congressional committees by the dozen have visited western lands in the past year, and out of their investigations and reports much good may come. But the industry is not dependent upon legislatures for its vitality. Economic laws transcend the statutes of all of these, and upon technical and economic foundations it has it within its power to build a strong and imperishable structure.

CONGRESS will be called upon to consider, during the coming session, the McNary Reclamation Bill, which has excited interest and both favorable and unfavorable comment in the industry. But it is doubtful whether definite action will be taken on it, for Senator McNary has hinted, privately, that because of the general condition of chaos surrounding reclamation, in which the Republican leaders of the irrigation committees in both house and senate are at variance with the administration, the bill may not be pressed in the coming session.

However one may look upon the policies of the present heads of federal reclamation, it is indisputable that the Reclamation service, so called, represents a most important phase of irrigation, and it is one which, during the year just passing, has received a large and increasing share of public attention; and may fairly be said to have accomplished some measurable steps of progress.

In the annual report which has just been submitted by Elwood Mead, Commissioner of Reclamation, covering the activities of the Bureau for the past fiscal year, it is shown that lands irrigated from federal reclamation works, in the period covered, produced crops worth nearly $110,000,000, an increase of $7,000,000 over the previous year. On the federal projects proper, 1,216,610 acres were cropped, the gross value of all crops being $66,488,560.

Construction work, under this Bureau's direction, for the conservation and utilization of the water resources of the nation has also made forward strides. Construction of the Tieton dam on the Yakima project, Washington, and the Black Canyon dam in Idaho, were completed; and the Gerber dam on the Klamath project has been virtually finished. Work is continuing on the McKay dam for the irrigation of the greater Umatilla project in Oregon, and the Bureau has begun work on the Guernsey dam of the North Platte project.

Perhaps more important than the work which the Bureau is doing with steel and masonry is that larger task to which it has devoted itself, of bringing reclamation out of its slough of financial debility to a point where it may function efficiently for the purposes for which it was first conceived.

THIS DEPARTMENT of its work, also, has been materially advanced in the past year. The secretary and the commissioner spent ten weeks in 1925 on tours of inspection of projects in the west. Although in some cases their visits were followed by indignant protests from the proponents of many of the projects, alleging that their "inspections" were casual and superficial, it can hardly be questioned that by getting in personal touch with the projects and the settlers, the responsible heads of reclamation have informed themselves more accurately of actual conditions and needs than they might have done in any other way.

In their effort to collect the money due the government from project settlers, they have encountered many vexing problems, but according to the annual report of the Bureau they have succeeded in the first steps of the task, and have collected hundreds of thousands of dollars from settlers who were able to pay, but who would not have paid except under the most insistent pressure.

Thirteen and a half million dollars have been authorized for expenditure on federal reclamation projects during the fiscal year of 1926. The last congress made direct appropriations totalling $4,330,000 for four new projects and for the extension of new areas on three existing projects that will entail an ultimate expenditure of $60,000,000. There is no danger that reclamation activity will flag for the lack of funds. Its dangers lie in other directions, and the fiscal policies of the Bureau of Reclamation, although they have been bitterly criticized, seem well adapted to protecting federal reclamation from future failures.

Irrigation in the Four Corners of the Earth

A Survey of the World's Important Water Developments Since the War

By THOMAS H. MEANS

THOMAS H. MEANS
Consulting Engineer

RECENT news items announced the completion of the Sennar Dam and the opening of the first irrigation canals near Khartoum in the Soudan. Probably few Americans gave the matter more than a passing notice and a still smaller number had any idea that this great irrigation project, on which cotton is to be grown, might have an important effect on the future of irrigation in our own Southwest. Irrigation work in America is going through a period of destructive, rather than constructive, criticism at this time and it is interesting to note that there are parts of the world in which large works are being built and kindly words spoken of irrigation and its possibilities.

As one looks over the foreign field one readily sees that irrigation is forging ahead more rapidly than at any time in the history of the world. Some of the largest irrigation works ever built have been commenced and completed since the World War, although none of these great activities has been in America.

FOREMOST among the countries in which irrigation work is being carried on are the colonies and dependencies of Great Britain. In India, Egypt, Soudan and Australia, very large works have recently been built and new areas of land colonized or old irrigated areas have been furnished with better supplies of water. There is a definite plan in all this work—a plan backed by the clear-visioned, farsighted Englishmen who control the destinies of the Empire. This plan is to grow for themselves the crops which supply the raw materials for England's manufacturers, and to make the nation independent of foreign powers as far as possible.

England has long been dependent on the American cotton growers, who produce sixty per cent of the world's cotton. This dependence on another nation for so essential a commodity has not been accepted with complacency by Great Britain, for obvious reasons, and for many years attempts have been made to grow cotton in the Empire, but with indifferent success. Now, however, there is every possibility that success will crown their efforts. Long deferred plans are being set in motion and there is every likelihood of these being carried to completion. Cotton is the main crop on the new irrigated areas in England's outlying territory.

THE INTERESTING bit of news first referred to—the completion of the Sennar Dam just before a Nile flood and the opening of the Gezirah canals—is one of the most important steps in Britan's great plan. The Gezirah lies just north of Abyssinia in the basin of the Blue Nile. The Sennar Dam, on that stream, is 249 miles above Khartoum. The arrea to be irrigated lies in the triangle between the White and Blue Niles. This area of three million acres of fertile soil in a tropical climate, suitable for the growing of all sorts of crops, is the largest single irrigation project ever undertaken.

The annual flow of the Nile approximates 75,000,000 acre-feet, about the average flow of all of the streams of California combined. Egypt has 6,000,000 acres of irrigated land and hopes some day, by reclaiming the salt lands and by pumping to higher levels, to extend the area to a little over 7,100,000. In low flood years there have been times when the amount of water at low flow was not enough to supply all of the land. Nearly every year dams of sand are built in the Deltaic branches of the Nile, close to the Mediterranean, to hold back the salt water and permit the last drop of the return seepage water to be pumped to the thirsty soil. In some years when a short supply of water is expected, the culture of rice is forbidden because of the large amount of water required at the time it is most deficient.

IT IS NO wonder then that Egypt has jealously guarded the upper waters of he Nile and objected to any use or diversion in Soudan. The proposal of the English Engineer officers to undertake irrigation in the Soudan was one of the causes of the separation of the Soudan from Egypt. Only since Great Britain's control of the upper country has been free from Egyptian interference has there been any real attempt to carry out the plans for irrigation in the Soudan, although these plans were proposed twenty years ago. This water right controversy was one of the underlying causes of the revolution in Egypt. It was only after exhaustive study of the problem and development of storage plans that the irrigation of the Gezirah could be undertaken. A recent communique from the Government Press Bureau in Cairo indicates that Egyptian officials are now satisfied that the Gezirah can be irrigated without depleting Egypt's water supply.

The Sennar Dam, estimated to cost over $7,000,000 and probably the largest structure ever built for irrigation, was completed last winter and used for the first time in 1925. It is a combined masonry and earth dam over two miles long and 110 feet high, which raises the water of the Blue Nile about 100 feet above low water. Sluices like those in the Assuan Dam permit the floods to pass without entrapping the burden of sediment so valuable to Egypt. The dam stores the last part of the floods, that part which is most free from silt, and raises the level of water to the canals. There are 3,000,000 acres irrigable from the dam, though only a million acres are included in the present development. Further developments depend on storage in Lake Tsana in Abyssinia or on the White Nile. In 1924 a part of the first unit of 300,000 acres was being ditched and prepared for water. The first crops of importance were grown in 1925.

Other projects are planned for the Upper Nile. A small project near Kassala, on the River Gash southeast of

Australia is making notable irrigation progress. This is a scene on the Morrumbridge Irrigation Scheme in the Antipodes. (Photograph by Courtesy of the Bucyrus Company.)

Khartoum, had 15,000 acres planted to cotton in 1924. This area is said to be capable of extension to 100,000 acres. On the White Nile reservoirs have been planned to supplement the water supply of Egypt, and Lake Albert in Equatorial Africa is to be controlled. A million acres of new land can be made available for crops and another million acres now producing one crop will be provided with water for irrigation the year 'round. Areas along the White Nile and in the valley between Khartoum and the Assuan dam may receive water from these new storage reservoirs. All of these plans are centered more or less around the production of cotton.

IN INDIA the Lloyd Barrage, at Sukur on the Indus, has been completed. This structure is one of the largest weir dams in the world. It is designed to raise the level of low water to canal height and to pass 1,500,000 second feet in flood. The canals command 7,500,000 acres, of which 6,000,000 are irrigable. Annual irrigation of 5,000,000 acres, of which 2,000,000 have heretofore received a partial supply, is expected. Canals of discharge of 30,000 second feet are to be built from this weir.

This area lies in the Sind, the hot lowland area of Western India. The soil is described as "black cotton soil," a description which gives a clue to the hopes of the planners of the enterprise. Native population already fills the country and will expand to take up all of the new lands brought into cultivation, for all that is necessary in an Oriental country such as India is to increase the food supply and the population automatically increases. Food crops will be the first consideration but the money crop will be cotton.

The Lloyd Barrage is not the only new irrigation project in India. Others smaller in scope are receiving attention and together they make up a considerable area.

NEARLY a hundred years of development of irrigation in British India have demonstrated that returns from irrigation are regular and profitable. Famine has been almost eliminated and the irrigated areas now produce an excess of certain products, among them cotton, for export. Important irrigation enterprises, such as the Lloyd Barrage, will come into profitable use more rapidly than was the case with the earlier works. In 1920, $80,000,000 had been invested in perennial canals in Punjab. In that year the profit above interest charges was 12 1-2 per cent of the capital expenditures. Other canals have returned much higher rates of interest.

One of the most interesting propositions emanating from England's irrigation geniuses is that of Sir William Willcocks to "re-create Chaldea." Fifteen year ago Willcocks made a study of the remains of irrigation works in the valley of the Tigris and Euphrates rivers and reported that "ten million acres once as fertile as a garden" could be put back in cultivation. The whole area is not cultivable at one time, as the water supply is not great enough, but he predicted that 7,000,000 acres could be supplied with water for winter crops. 1,000,000 acres for rice, and 3,000,000 for summer crops (among which cotton is mentioned). The region at the time of Sir William Willcocks' survey was ruled by Turkey. Since the war it has been under the control of England—the mandate of Iraq.

Unsettled political conditions have not permitted the carrying out of the plans to increase the irrigated area, but we may expect to see the lower valley of these streams once more the granary of the east unless there is some break in the friendly relations among the nations of the world. Grain will, however, not be as important as it was in the days of Babylon, for with modern transportation the irrigators will find that they can grow an acre of cotton and with the crop buy the product of several acres of wheat or corn grown in the temperate zone. A few years under the control of a peace-loving people such as the English and we will once more see the valleys of old Mesopotamia as "fertile as a garden."

THE irrigation activities of the British Empire are not confined to the countries of dark skinned people. Canada, Australia and South Africa are all interested in extension of irrigation. We find in these countries, however, much the same conditions as are found in the United States—financial troubles and the necessity of colonization attended with indifferent success in the first years. When we look into the reason for the difference in the conditions, it is at once apparent that a very different method of financing has been used. In the case of the Oriental and African irrigation developments, the cost of the irrigation works is a governmental expense and there is no attempt to collect the capital expenditure from the water user. Taxes are raised from the land user and from all of the taxable properties and industries which grow up with irrigation. The taxes are graded to the ability of the irrigator to pay, light at first and increasing in later years.

In the countries where the population is white, the method of financing which has been followed almost uniformly is to sell the land and the water right to the water user. In the period during which the right is being paid for, the user of water has the cost of maintenance and the installments on the construction cost to pay. Thus at the time when the land is new and the agricultural industries imperfectly organized, the farmer is called on to pay heavy charges. In Egypt, for an instance of the system in the Eastern countries, all costs of operation and support of the country are raised from taxes on the irrigated land. Where so large a part of irrigation works has been built for many years, there is no interest to pay on bonds and the settler has only the upkeep and operation charges in his tax bill.

Interest in the extension of irrigation facilities is not confined only to the countries under British rule. The

(*Continued on Page 32*)

When the Solons *Took Off* Their *Coats* and Went After the *Facts*

Senate Committee Studies Colorado River Problem at First Hand

By CARLETON D. JOY

Hiram and Key (Senators Johnson and Pittman) sans coats, vests and some of their senatorial dignity.

MAJESTIC canyon walls, towering above the turbid waters of a mighty river, are a more potent argument to spur the determination of men bent upon building empires in desert wastes than volumes of logically compiled data, spread out on committee tables by corps of engineers.

Two years of congressional committee hearings in Washington—in which experts who have studied the lower Colorado River have repeatedly testified that the west must store the wealth of this great national resource—failed to bring forth a show of enthusiasm comparable to that which followed the half day's trip into Black Canyon by the senatorial committee on Irrigation and Reclamation early in November.

TEN United States senators, members of this committee, called upon their full powers of oratory to declaim upon the future that is the west's as the result of stored waters in these same canyons; and vied with one another in word pictures of the great dam that is contemplated.

In the shadow of those towering granite walls at Black Canyon, between Arizona and Nevada, a vision of a huge concrete wall behind which millions of acre feet of water may be impounded, came nearer joining hitherto uncompromising interests in a common project than all the argument, compacts, conferences and testimony devoted to development in the Colorado had ever done. The west may rightfully be optimistic about future reclamation of its deserts and hydro-power.

One might safely say that three major, all-important considerations crystallized in the hearings before the Senate Committee at Los Angeles, San Diego, El Centro, Yuma, Phoenix and Las Vegas during the last week of October and the first week of November. Those considerations are: Construction of a high storage dam at Black Canyon to impound 26,000,000 to 34,000,000 acre feet of water in the Boulder Canyon reservoir as the initial step in a super-plan that will ultimately develop the entire Colorado River; provision that American lands alone will be benefited by this project and that Mexican lands must shift for themselves; formulation of an interstate agreement in which all the states in the Colorado basin arrive at a settlement of the differences which now divide them.

AT LAS VEGAS, on the eve of adjournment of the committee sessions, there was a strong note of optimism expressed by each of the senators in turn as each briefly summarized his views gained in the tour of the southwest. And in each instance there was the admonition, directed particularly to California, Arizona and Nevada, to work out some agreement with which to approach the upper basin states so that the west will stand as a unit for development of its water resources.

From Senator Phipps of Colorado, Senator Kendrick of Wyoming, Senators McNary of Oregon and Jones of Washington the same declaration was repeated: namely, that the west has it within its power to develop the Colorado through the federal government. Whether the approaching sessions of Congress will witness the passage of some definite legislative measure in accordance with these conclusions is conjectural; and even the most ardent advocates of the Swing-Johnson bill in the Senate Committee would not prophecy as to its fate. One thing, however, is certain. Congress will hear from the west in the most graphic and convincing language that these able men can bring to their aid. Washington will be the scene of a great campaign for irrigation and power this winter.

The senators as they boarded the special train that took them thirty miles into Mexican territory to study the lower river. Left to right: Senators Phipps of Colorado, Ashurst of Arizona, Pittman of Nevada, Shortridge of California, McNary of Oregon, Kendrick of Wyoming, Oddie of Nevada, Johnson of California, Jones of Washington, Dill of Washington and Cameron of Arizona.

Spillway of Pit No. 3 Dam of Pacific Gas and Electric Company on Pit River, California—a typical example of great power projects under permit from the California Division of Water Rights.

Water Developments Depend on Valid Rights and Titles

By EVERETT N. BRYAN

Deputy Chief, Division of Water Rights, California State Department of Public Works

THE RAPID development of a state's water resources is dependent, in large degree, upon the readiness with which water titles may be established. This is especially true in California. It is estimated that there are still, in this one western state, some 12,000,000[1] acres of agricutural land to be brought under irrigation and 5,200,000[2] potential hydroelectric horsepower to be developed. More than two and one-half billion dollars will be required for these two classes of water developments alone; and, in addition, there is the capital required for mining, municipal, and domestic water supply developments. This tremendous amount of capital will become available only when and as title to the use of the necessary water is established and made secure.

California is confronted with a peculiar situation in the matter of water rights because of the two conflicting doctrines by which titles are derived. Under one doctrine the right to use the water flowing in a stream is inherent in the land which borders the stream and dependent purely upon land ownership. The right is neither created by use nor forfeited by dis-use. It is limited to the watershed through which the stream flows but recognizes no tenet of priority. This is the doctrine of riparian right. It is derived from the common law of England, which by statute of April 13, 1850, was adopted as the rule of decision in all courts of the state insofar as not repugnant to or inconsistent with the constitution of the United States and the constitution or laws of California. The decision of Lux vs. Haggin (69 Cal. 255) in 1886 firmly fixed this doctrine upon California as one which must be reckoned with in determining water titles.

OPPOSED to this we have the doctrine of appropriation which was born of the necessity of the miners before California was admitted to statehood. It is based upon use, is forfeited by non-use, is independent of any natural contact with the source or the watershed from which diversion is made, is independent of land ownership, and recognizes that "first in time is first in right." This doctrine was recognized from the earliest mining days but was first incorporated in the laws of California in 1872 by the adoption of Civil Code Sections 1410 to 1422, which sections were later superseded by the adoption of the present Water Commission Act (Chapt. 586, Stats. 1913).

The development of California's water resources has proceeded now for 75 years under these two opposing and irreconcilable doctrines. There are no accurate figures as to what percentage of the total development may be claimed by either, but it has been estimated that only one-sixth[3] of the irrigation development has proceeded under claim of riparian right. Since 1860 there have been some 700 supreme and appellate court decisions on water matters and most of these are traceable to the conflict between these two opposing doctrines.

In order to eliminate some of this difficulty, Section 11, Chapter 586, Statutes of 1913, was enacted by the legislature of California in 1913. This statute in part provides that ten consecutive years non-use of water upon riparian lands shall constitute conclusive presumption that the water not used is not needed upon the riparian lands and that it shall accordingly become subject to appropriation. There are those who maintain that this provision is unconstitutional, but it probably is a safe assumption that by far the greater part of California's future development of water resources will proceed under the doctrine of appropriation rather than the doctrine of riparian right. The simpler developments which border the stream are for the most part already accomplished. The developments of the future will, in the main, be of greater magnitude and involve the transportation of water to non-riparian lands.

The Water Commission Act, enacted in 1913, with subsequent amendments, gave California for the first time a complete water code. It provided the means whereby appropriative rights could be initiated, adjudications and determinations of existing rights could be undertaken by impartial experts, and stream systems could be administered in accordance with the determined rights. Were it not for the conflicting doctrine of riparian right and the

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(1) Bulletin 4 Division of Engineering and Irrigation, p. 25.

(2) Report of U. S. Geological Survey, April 29, 1924.

(3) See Fifth Biennial Report of Division of Water Rights (Calif.), 1924—p. 21

Congressman Smith on Reclamation

It is our obvious duty to render possible the acquisition of lands and homes by our citizens through reclamation.

The west must sell reclamation to the entire country. It should undertake a campaign of national publicity.

To do this successfully it must abandon projects which are merely local and concentrate on plans national in scope.

The passage of the Smith-McNary bill by Congress would be assured if it were backed by the states most interested.

Reclamation has not been a failure. It has been a great economic success in spite of isolated examples of failure.

Increasing population, abandonment of a million acres of eastern crop lands yearly, and our dependence on other nations for food supplies indicates a need for extended reclamation.

Co-operative marketing is a logical development to accompany extended reclamation. Congress will probably enlarge the co-operative work of the Division of Co-operation.

Thoughts on Reclamation as the 69th Congress Meets

By ADDISON T. SMITH

Representative in Congress from Idaho

Chairman, House Committee on Irrigation and Reclamation

THESE are the underlying reasons why the federal government is and should be concerned in reclamation. There is no greater stability in government than the security which the individual feels in the acquisition of lands and home. Home-owning and land-holding typify a higher standard of citizenship and give a clearer vision and understanding of our institutions.

The inevitable increase in our population foreshadows the hour when the Nation must give thoughtful consideration to the problem of distributing its people. The permanence of our institutions can not be safeguarded if we disregard our obvious duty to render possible the acquirement of homes by our citizens. It is the blending of the virgin, fertile soil of the arid lands of the west with the water from its ever-flowing streams that eventually will reclaim these lands—20,000,000 acres of them—and transform a desert empire, dotting this great area with substantial farm homes and squared fields of pastoral grandeur.

WE OF THE WEST have a most important duty to perform, and that is to sell reclamation to the whole country. There should be a unified effort on the part of the west to initiate a campaign of publicity to educate all the people to an appreciation of the material benefits which flow from this work.

In order to do this successfully we shall have to disregard local projects for the time being and concentrate on plans national in scope. In other words, California must indicate the same reciprocal spirit of interest in the demands of Georgia, Alabama and other states for recognition in the federal policy as she expects to be shown for her own projects.

It must not be forgotten that national reclamation became a definite policy of the government not wholly by reason of western effort. The passage of the present law was due in part to the generous support of the south, and some of the manufacturing centers of the east. For this reason the west is bound to give consideration to the interests of these sections in all propositions looking to an expansion of land reclamation and development.

MANY PEOPLE concerned in the extension of reclamation are interested in the Smith-McNary bill, drawn after careful consideration of the demands of many states. There are many available projects in the west and south awaiting the co-operation of the federal and state governments toward their reclamation, most of which would be able to meet the conditions which that measure would impose.

If the Smith-McNary bill were enacted into law, it would launch a nationwide program of home-making on a self-sustaining and self-continuing basis with benefits widely distributed. Its approval by Congress would be assured quickly if it were backed by the states in which the opportunities are greatest for its application.

Organizations for carrying on this educational work should be developed in all the states. The greatest effort should be concentrated upon a broad and definite policy that would be forward-looking, practical and thoroughly businesslike.

As expenditures under the policy contemplated by this bill are reimbursable, no taint of petty politics can attach to it; rigidly supervised by practical engineers of experience, each project would stand upon its own merits.

Such a policy would secure prompt and favorable consideration from Congress, where local measures would not, if it were properly presented to Congress and strongly endorsed by the public. It would contribute greatly, when put into effect, to the welfare of the whole country.

THE QUESTION is being seriously put: "Is reclamation a failure?" The reclamation policy of the government, adopted in 1902, has been a great economic *success,* regardless of the unfavorable criticism which has grown out of the failure of settlers on some of the projects to meet their obligations promptly. Nearly 3,000,000 acres of desert land have been transformed into approximately a billion dollars worth of national wealth, bringing to the counties, states and federal government millions of dollars annually in taxes. Near-

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Because of the difficulty of finding a market, much power that might easily be developed is wasted in unharnessed water. These penstock openings in the Elephant Butte Dam, New Mexico, are symbolic of the potential but unused power that remains to be efficiently utilized from present irrigation developments.

Electric *Power* and *Water* for Irrigation are *First Cousins*

But There Are Some Puzzling Problems Involved in Making Them Pull Together Efficiently

By IRVING C. HARRIS
Consulting Engineer

IT IS very natural that irrigation and hydro-electric power should be closely associated; for the reason that electric power is involved, in one way or another, with a very large proportion of all irrigation enterprises.

Many irrigation projects require power for pumping water from wells, from streams, or from one canal to another. Others require it for pumping drainage water, either from wells or from drains. A considerable number of irrigation projects are, or possibly may become, producers of hydro-electric power as a by-product.

Though closely associated, irrigation and hydro-electric power usually have peculiarities that are decidedly difficult to harmonize. It is well known that irrigation is seasonal, and calls for the use of water in amounts which gradually increase from nothing, or almost nothing, during the early months of the year, to a maximum during the summer months, and then decrease to nothing, or almost nothing, during the last months of the year. The average rate of use for the entire year is always less than half the maximum rate.

POWER applied to pumping irrigation water, and hydro-electric power generated as a by-product at storage reservoirs,—built for irrigation,—must have this same characteristic fluctuation throughout the year, except in a few cases where special provisions have been made to eliminate them.

The ordinary uses to which hydro-electric power is applied call for power at times of the year that are very different from the times of similar demand, or available supply, on irrigation projects. For instance, most power companies sell large portions of their output for electric lighting, heating, cooking, electric railways and industrial uses; and they most commonly experience their period of maximum demand,—or peak load,—in the winter instead of in midsummer. Thus the two are as nearly opposite, as regards distribution of use throughout the year, as it is possible to be.

On an irrigation project which has by-product power, either developed or potential, at storage reservoirs, irrigation is usually the primary object and power secondary; for the reason that the products obtained from the use of a given amount of water used for irrigation bring a much higher money return than the sale of power generated from the same amount of water. This establishes the general rule that it is not desirable to use stored water to generate power when such use will decrease the amount available for irrigation.

AS A CONSEQUENCE, the utilization of this by-product power requires the finding of a market, or a method of disposal of the power, which can adapt itself to the very special characteristics of the supply. Except in special cases, this requires stand-by plants or other methods of compensating for the shortage of power during the non-irrigation season.

It sometimes happens that by-product power of this kind can be sold to other irrigation projects that use power for pumping their water supplies. This makes a mutually satisfactory arrangement, because such projects naturally irrigate at substantially the same times as the one generating the power.

The Salt River project, in Arizona, is the most conspicuous example of a project that involves irrigation and by-product hydro-electric power; and it includes about every set of conditions that can be encountered.

During the earlier years of the Salt River power system, its power output had the peculiar characteristics above described; but it was possible to dispose of the entire output. One mining company has used more than one-half of the output of the five plants. This company has its own steam power plant and generates a part of its power all of the time, and a larger part, or all of it, when the output of the Salt River system is reduced. Certain special problems encountered by the mining company were greatly helped by this arrangement; and the two sets of peculiar conditions fitted together in a manner that materially helped to solve the problems that confronted both parties.

The Salt River project itself is a large user of its own power for pumping from wells, for drainage and for additional water supply, and, also, for pumping from a canal to a highline canal. There are several irrigation projects adjacent to the Salt River project that use water pumped from wells. As their demands for water, and, consequently, power, coincide very closely with the output of power on the Salt River System in point of time, they purchase their power on mutually beneficial contracts.

A LIMITED AMOUNT of power is sold by the Salt River Project to power companies and municipalities that use it for lighting and general power purposes. The largest user of this class maintains its own steam reserve. There have been times when power generated in customer's reserve steam plants has been purchased by the Salt River Project

for its own uses, or for serving other consumers not supplied with reserve, during periods of power shortage.

The Salt River power system has been so successful that the project is now proceeding with an enlargement program which was always contemplated as an ultimate development of the power system, but not previously promoted because the time was not ripe. This involves the building of a regulating reservoir at Mormon Flat, now completed, and a high dam and power plant, now being built, at Horse Mesa, between Mormon Flat and Roosevelt.

The completion of these reservoirs and plants will make it possible to hold over, in the Mormon Flat Reservoir, water that is used by the Roosevelt and Horse Mesa power plants for power purposes when not required for irrigation. This makes it possible to generate power continuously without waste of irrigation water, and largely removes the peculiarities of this kind of by-product power.

THE Rio Grande Project has a large potential power site at the Elephant Butte Dam, in New Mexico, which has not been developed for the reason that it has not yet been possible to secure a market for the power on account of its lack of continuity. It is probable that a market will be developed within a short time and the proposed power system built. A regulating reservoir, similar to the one built on the Salt River Project, is being considered and will possibly be the means of eliminating the handicap which has prevented development thus far.

There are a number of irrigation projects in California, either constructed, being built, or proposed, that involve large storage reservoirs and power sites which have characteristics very similar to those described above. In some cases, the disposal of their by-product power is best accomplished by selling the output at wholesale to large power companies who are able to absorb it into their large systems in spite of its peculiarities.

Many of the hydro-electric plants operated in California by the power companies use water from streams that are not controlled by reservoirs. The water usually belongs to irrigators below the plants, and must be so used as not to disturb its natural flow or interfere with irrigation. In such cases the output of power has a distribution throughout the year that is different from enterprises that have storage reservoirs; and it is generally characterized by a reduction in the output, especially in dry seasons, during the late summer, or at approximately the same time that a project having storage has its greatest output. For this reason, the power companies having such plants should be able to absorb by-product power from storage projects quite advantageously.

The Modesto and Turlock irrigation projects have worked out their power disposition problem and are operating a power plant at the Don Pedro Dam. The Merced Irrigation District has financed and is building a power plant at the Exchequer Dam which will deliver its power to one of the large power companies.

In Arizona, Salt River water does double duty. It first generates electrical energy and then irrigates the desert soils, while the power which it has created passes through substations like this one on the Litchfield Ranch of the Southwest Cotton Company, to pump water from wells to irrigate other lands.

An up-stream view of the Roosevelt Dam, which supplies power for the Salt River Valley Project, which is, perhaps, the most conspicuous example of how power and irrigation may be made to work together for reclaimed territory.

MANY of the large storage reservoirs built by the United States Reclamation Service, including the Pathfinder, Shoshone, Arrowrock and others, have large potential power sites which have not been developed because of the seasonal characteristics and lack of market.

The irrigation and power possibilities of the Colorado River are so enormous that the peculiar characteristics described above, though present, will have little effect, and are partly counterbalanced by other conditions. The magnitude, distance from the market, and diversity and conflict of interests, are the problems that have to be solved.

Assuming a power plant to be built at a storage reservoir at the Boulder Canyon site, capable of regulating the entire river, and that the water is to be released from this reservoir only as needed for irrigation of the lands below it, the power output would be similar in distribution to that at the Roosevelt and Elephant Butte reservoirs, without regulating reservoirs below them. However, since it will be a long time before all of the water can possibly be applied to irrigation, there will be, for many years, an excess of water that can be discharged from the reservoir at will to suit power demands and flood regulation without disturbing irrigation.

TO SERVE best for flood protection of the Imperial Valley, the flow of the Colorado River below Yuma should be kept nearly constant. This will suit the requirements for general power purposes very well and, also, the demands for irrigation as long as the peak demands can be met by such regulation. When the time arrives, many years in the future, when all of the water will be needed for irrigation, the irrigation interests will demand that the flow below the last reservoir on the river be regulated to suit irrigation.

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Credit is Your Most Valuable *Asset*

This Article Suggests Means By Which It May be Established and Maintained

By B. J. SEGER

Secretary-Treasurer of the North Platte Valley Water Users Association and the Farmers Irrigation District, Scottsbluff, Nebraska.

WHEN irrigation in the United States was young and there were but few irrigation systems and a comparatively small acreage under irrigation, the financing of the projects was not so important as it is now. In those days the large individual land owners constructed the small projects, if there were no special engineering problems involved, and also did a great deal of the operative and maintainance work. The land owner, as a rule, donated his work and if other labor was employed and materials purchased, warrants having no maturity date were issued in payment. These warrants were usually sold to the local bank or to some individual, and, as a rule, were discounted from 5 to 15 per cent.

Now that larger canal systems have been built and many more are in the course of construction ,some of which require millions to complete and many thousands per year to operate and maintain, the matttr of financing irrigation projects, especially those of considerable size, has become correspondingly more important. It is, therefore, more necessary that the matter of credit for irrigation projects be given serious consideration.

The irrigation district form of organization seems to be adopted by the greater number of irrigation projects. Especially is this true on the larger projects which have been organized in recent years.

CALIFORNIA enacted the first irrigation district law in the year 1887, known as the "Wright Act." Other states have enacted similar legislation with some modifications, but in the main the provisions of irrigation district laws are the same today.

The advantage of an irrigation district form of organization is that each acre of irrigable land must bear its proportionate share of the tax levied for the building of the project and for its yearly operation and maintenance. Bonds may be issued and sold to secure funds to pay for the construction of the canal system, and for making additional improvements. The irrigation tax as a rule is collected along with the state, county and school taxes.

A common mistake made by directors of newly formed irrigation districts is in not making sufficient levy in the first years to allow for delinquent taxes, with the result that sufficient funds are not collected to meet interest coupons and other obligations when due. Unless provision is made the following year to make up such deficiency, and due allowance made to avoid a similar shortage, the credit of such districts will become impaired and it will require several years of careful management to re-establish it.

AN IRRIGATION district which pays its obligations promptly when due can secure a better price for its securities than a district which issues warrants and allows them to run for years before being paid, or which allows other forms of indebtedness to drag for an indefinite period. There is no reason why irrigation securities should not sell on a par with other securities if some provision is made for the protection of the purchaser from loss.

The time is past when a dishonest promoter can build an irrigation project having little or no water supply, and sell the lands and the securities of the project to the unsuspecting public. Practically every state having irrigated territory now has laws which make it impossible for such frauds to be perpetrated.

Investors are learning that irrigation securities are as safe as any investments, provided a thorough investigation, made by an expert on irrigated lands and finance, shows the following facts:

1. A large per cent of first and second class land which is capable of producing large yields under good farming methods.
2. An ample supply of water for the land to be irrigated and an unquestioned water right granted by the state.
3. At least 75 per cent of the irrigable lands being farmed by resident farmers.
4. A reasonably close market for the marketing of the products of the lands.
5. The class, financial condition and number of people living on the project.
6. A bonded debt which is not excessive.

SOME of the larger districts, through their directors and officers, handle either directly or indirectly as much money during the year as a bank or a large business institution.

In order that the credit of an irrigation district be placed on a firm foundation, it is important that the landowners of the district shall select men to represent them on the direcorate who will take a real interest in the business affairs of the district—men who will realize the responsibility placed upon them to the extent that they will use as much care and judgment in looking after the business of the district as they do in their personal affairs.

If the members of a district board are busy men—too busy to give the affairs of the district sufficient time and attention—they should employ a business manager to manage the finances of the district and other important details.

Where there are a number of small irrigation projects in the same territory, it might be feasible to employ a business manager to handle the finances and other business of several projects. Many districts get into bad condition financially through neglect, while if the business of the district were handled by an experienced business manager, the credit of such districts could be kept in first class condition.

It is an established fact that those projects having at least one of their officials a man of business experience, especially in irrigation finance, to handle the finances of the district, have no difficulty in selling their securities at a good figure, or in borrowing funds when emergency arises which would make this necessary.

LANDOWNERS under a project should be made to realize that they are the organization and that they have an important part in helping officials to maintain the credit of the district. There should be closer cooperation between the officials of an irrigation district and the landowners. No matter how competent and efficient the officials may be, if the landowners do not cooperate in every way possible, the dis-

(*Continued on Page 44*)

This article by Mr. Seger is the first of a series of two which he has written for MODERN IRRIGATION *on the subject of "Credit for Irrigation Projects—How to Establish and Maintain It." The second article will appear in an early issue.—Editor.*

Machinery Replacing *Pick* and *Shovel*

Mechanical Equipment for Trench Digging, Pipe-Laying and Back-Filling Described

By THOMAS BROOKS

Superintendent in Charge of Domestic Distribution and Supply, Bureau of Water Works and Supply, City of Los Angeles.

PREVIOUS to the World War the Bureau of Water Works & Supply of the City of Los Angeles had given very little thought to the use of mechanical equipment for the excavation of trenches, the laying of pipe and backfilling of trenches. Up to that time there was a plentiful supply of efficient labor at wages which were very reasonable from the employer's standpoint. The war, however, was the cause of a great change in this respect. During that interval and almost up to the present time efficient labor for trenching and pipe laying was not available; which will explain in part why the Bureau is now so well equipped with mechanical apparatus for handling this class of work. Economy is another important factor worthy of consideration, as a result of the change from the old to the more modern methods.

Phenomenal growth of Los Angeles during the last three years, necessitating the extension of our mains to supply new subdivisions being put on the market, required the installation of from 75,000 to 140,000 feet of pipe per month; and in addition to the large volume of trunklines and betterments it became absolutely necessary, in order to meet the growing demand for water, to speed up our work in every way possible. By introducing modern mechanical equipment we have been able to meet this condition very satisfactorily.

AT PRESENT we have a fleet of seven pipe trenching machines, two in the San Fernando Valley and five for the city proper,—of these four are the "P & H" and two the "Buckeye" wheel type excavators, for excavating trenches from 18 inches to 21 inches in width and approximately 7 feet in depth; one ladder type "Buckeye" machine for excavating trenches from 24 inches to 42 inches in width and approximately 8 feet in depth.

In new tracts, where there are no obstructions, the small machines will dig a trench from 2500 to 3600 lineal feet in eight hours at a cost for operation, helper and fuel of approximately $18.00, the average depth of trench being 3½ feet. The large excavators are capable of digging a trench 42 inches in width and 5½ feet in depth and a length of from 500 to 1500 feet in eight hours at a cost (not including upkeep or depreciation or overhead) of about $25.00.

On account of the time consumed in moving the machines from job to job and the delay occasioned by break-downs, the average footage of trench excavated per machine for a period of several months would be very much less than the figures above quoted. As to depreciation, the oldest piece of equipment of our present fleet has been in active service for five years and I feel sure it is good for at least two years more. Four of the wheel type machines over a period of eight months dug a combined total footage of 549,446 feet of trench varying from 18 inches by 3 feet to 21 inches by 4 feet, at a cost per lineal foot, including gasoline, cylinder oil, repair material, repair labor, operator, moving expenses, and overhead, of five cents per foot. Our ladder type machine dug 100,000 lineal feet of trench, ranging from 31 inches by 4½ feet to 42 inches by 5½ feet, at a total cost (depreciation not considered) of six cents per foot. The Department has a twenty-ton low trailer for moving the wheel type excavators from job to job.

BACKFILLING of trenches is done by two Holt push-blade backfillers, and two P & H trench backfillers. The Holt machines will backfill an 18-inch by 3-feet trench at the rate of from six to eight thousand lineal feet per eight-hour day. This is considered a very economic and reliable machine. For backfilling trenches 24 inches and up we use the P & H backfillers with or without the boom. With the boom attachment one operator can backfill from five hundred to seven hundred feet of 36-inch trench per eight-hour day. These machines are moved from job to job on one of our large trucks or on a twenty-ton capacity trailer. For digging bell holes in hardpan or sandstone we have quite a number of pneumatic spades which are also very useful for tunneling below railway and other structures. One spade will accomplish the work of about four laborers working with picks.

For cutting concrete pavement the Department has several pneumatic concrete breakers. This method of breaking concrete is such an improvement over the old method of gad and sledge that there is no comparison between them.

Compressed air for caulking lead joints, filed riveting of sheet steel mains, driving the pneumatic spades, concrete breakers, cutting cement joints from cast iron pipe and for a multitude of other purposes is furnished by three Ingersoll-Rand Compressors each having a capacity of 212 cubic feet of air per minute and mounted on 2½-ton capacity trucks.

For lowering and placing in the trench, cast iron pipe of the larger diameters (i.e., 20-inch, 24-inch, 30-inch and up) and for handling large valves and fittings, we are using an "O & S" Truck-Crane mounted on a five-ton capacity truck; and after using this crane continuously for several months handling 24-inch Class "C" cast iron pipe, I have found it to be satisfactory in every respect and I can highly recommend a crane of this type. We also have a smaller truck-crane for handling loads of one-ton and less. For unloading pipe from cars and loading trucks at our pipe yards, the Department has one "P & H" and one Brownhoist Crawler tread-type forty-foot boom crane. It would be almost impossible for the Department to handle the large tonnage of cast iron pipe received without the aid of these cranes, which have proved to be all that is claimed for them by the respective manufacturers.

FOR TRENCH PUMPS we have one nine-hundred gallon-per-minute centrifugal pump, mounted on a four-ton truck, together with a generator for furnishing current to a large number of electric lights for night work; in addition to the pump and generator this truck also carries a 178-cubic-foot-per-minute air compressor. All of the above equipment is operated by the truck motor.

For handling smaller quantities of water, four power driven diaphragm pumps are used, mounted on small rubber tired trailers, which are good for 12,000 gallons per hour each. We also have an electric driven emergency trench pump and lighting plant mounted on a

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This article was presented as a paper by the author before the recent meeting of the California Section of the American Water Works Association, in annual session at Santa Cruz, California.

The EDITORIAL

MODERN Irrigation

An Organized Voice for the Forces of Agriculture and Industry Which are Primarily Dependent upon Irrigation.

Published Once a Month

AT LOS ANGELES, CALIFORNIA, BY THE

PETROLEUM WORLD PUBLISHING CO. *Editorial and Executive Offices, 626 South Spring Street, Telephone Broadway 3262.* Branches: SAN FRANCISCO—447 SUTTER STREET, *Telephone Garfield 2772;* H. E. TAYLOR, *Manager.* CHICAGO—1163 MONADNOCK BLDG., *Telephone Wabash 8855;* JOSEPH E. O'CONNOR, *Manager.* NEW YORK—503 FIFTH AVENUE, ROOM 308, *Telephone Vanderbilt 8753;* WERNER HAUPTLI, *Manager.*

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DOUGLAS G. MCPHEE
Executive Editor

By Annual Subscription in the United States and possessions, $2.00; Foreign, $2.50; Single copies on sale in the irrigation country, 20 cents. In ordering change of address, give both the old and the new address. Allow ten days for re-entries on the subscription list. Advertising rates and circulation data upon request. Checks should be made payable to Petroleum World Publishing Co.

VOL. I DECEMBER, 1925 No. 6

Water for the World

THE WHOLE WORLD is interested in irrigation. The remotest parts of the globe are transforming their arid lands into garden spots by the intelligent use of water. In Egypt and India, in Spain and Italy, in Australia and Mesopotamia, there has been renewed interest in the construction of works for the development and distribution of water since the end of the great war.

As a matter of fact, there are many indications that America itself is being outstripped in the irrigation race. Egypt and India, where irrigation was practiced in remote historic times, are now, in the twentieth century, under the progressive colonial policy of the British, bidding fair to assume the leadership in irrigation activities once more.

In many other countries of the world, and particularly in British colonies and dependencies, constructive endeavors looking far into the future are in progress. In the United States such progress as is being made is very slow, considered from the perspective of the entire nation. We seem, according to one qualified authority, to be suffering from an aggravated case of "inferiority complex" in our confidence in the necessity for and the value of irrigation progress, and, after leading the world for twenty years in the extent of irrigation development and boldness of engineering skill, "we now sit supinely by and watch with half-hearted interest the evidence of progress in other countries." Soon we may again be sending our engineers to foreign countries to learn how these things are done, just as we did twenty years ago.

And yet there is no other nation that has the opportunity that is the United States' to maintain a recognized leadership. And there is no other continent that offers such a field for development as does North America.

In an article in this issue, an eminent irrigation engineer presents a broad survey of some of the most significant developments taking place in the four quarters of the globe. It is worth reading for many reasons, but perhaps most of all for the realization which it brings that we must bestir ourselves if we would maintain our "place in the sun" of peaceful, constructive and beneficent development.

A Factor in World Politics

IN THIS ARTICLE, irrigation is presented as more than a matter of engineering and economics. It is becoming a great factor of international politics. The statesmen of Great Britain are still looking out from Downing Street at an Empire which they would make self-supporting and self-dependent. The control of staple crops is essential to that dream's realization, and cotton assumes a dominant role in the plan. They are not content to be dependent on any nation—not even friendly and peaceable America—for their supply of this essential raw material, and by the construction of great irrigation works they are seeking to create a cotton producing empire in their colonies that will assure them of an adequate supply for their own factories.

The extension of the irrigated territory of the colonies for this purpose has long been contemplated, but several factors combine to make it possible today where before it was not. The high price of cotton is the greatest factor, but that unswerving determination to carry forward public works in the British dependencies is another important one. Larger sums of money than ever before have been set aside for public works. The incredibly enormous amounts expended in the conduct of the war have not proved a deterrent, but have rather proved a stimulus to such development. The few millions of dollars required for irrigation, to increase the land resources of the empire, to give it new and larger crops, and to put it in a strategic position for self-support and self-defence, seem insignificant alongside of the billions prodigally provided for the wasteful, futile use of war.

Peaceful Imperialism

THE SENNAR DAM, which will make 3,000,000 acres irrigable, is only one of the projects under-

POINT *Of* VIEW

taken by the far-seeing English for the express purpose of growing cotton and securing freedom from the dominance of the American grower. Part of the plan of this project is to keep, for the production of cotton, one-third of the area thrown open to agriculture by its completion. Definite plans are already under way for the irrigation of a million acres under this one project, and enough is known of the possibilities of storing water in the lakes of Abyssinia to assure at some future time the extension of this area to the full limit of three million acres.

Irrigation thus assumes the key position in international politics, ranking with the control of the oil fields of the world, or the possession of the great coal and ore deposits, as the *sine qua non* of world power. But there is this difference —every acre of new irrigated land is an achievement, first, in the direction of peace, rather than war, for it opens the way for an expanding, home-keeping population. And there is this other difference—the nations may struggle over their rival claims to Alsace-Lorraine, or the oil fields of Mesopotamia, but each one can find within its own boundaries or that of its colonies ample room for the peaceful imperialism of irrigation.

This Man Work

HUBERT WORK, Secretary of the Interior, must be eminently satisfied with things in general if he agrees with the famous dictum that it makes no difference what people say about one if they only say something. For both his friends and his critics find him an absorbing subject for discussion.

Recent editorial utterances in national journals as far removed in purpose and policies as the *Outlook* and the *New Republic* have recently taken occasion to commend Secretary Work's administration of the Interior Department, and to approve particularly his policy of reclamation. The *New Republic* sees in his frank statements and forthright attitude toward the problems of the Bureau an indication that reclamation is to be put upon a business basis, free from the pork-barrel tactics which in many cases have been a blot on federal aid projects of various kinds in the west. The *Outlook* declares:

"It is useless to cry over spilled milk—or wasted water. What has been unwisely done can not now be undone. Much of it can be abandoned, and the cost charged to experience, or politics, or profit and loss, or what you will. Some of it can be bettered by the spending of more money. Most of all, the repetition of those errors can be avoided if Congress will have the sense and take the time to change the Reclamation laws. No time need be spent in finding out what needs to be done. That has been very well found out by the fact-finding committee appointed by Secretary Work. . . . .

"Their report is unanimous. It has lain in the archives of the Senate for a year and a half. It will stay there unnoticed for a century and a half unless the people . . . wake Congress up to their duty . . . . If it will, Congress can reclaim Reclamation."

The Other Side

LOOKING at the other side of the strange case of Dr. Work, "Uncle Henry," in *Colliers*, expresses in characteristic fashion the criticism which is often heard among reclamationists who disagree with the present administration. "Uncle Henry" is not always kind in his comments, and occasionally sacrifices fairness to humor, but his reference to the qualifications of Secretary Work is good fun even if it is not good argument. He says:

"An' consider the case of Doc Work, now holdin' down the chair which Albert Fall was kind enough to leave behind. When Hubert, as a youth, decided that he wanted to be Secretary of the Interior he didn't make the mistake of travelin' through the West, familiarizin' himself with irrigation, timber lands, coal an' oil, grazin' ranges an' the moods of mountain sheep. Not on your life! He took up medicine, cultivated a bedside manner an' refused surgical cases so's people wouldn't associate him with the Interior Department. An' look how it worked out.

" 'Who's that man I see goin' by the house every day with a black satchel?' asked the President one mornin'. 'Looks like he ought to make a good Secretary of the Interior.'

" 'Oh, him!' answered one of the confidential clerks. 'Why, that's Good Old Doctor Work. Thirty years' experience an' never used the knife.'

" 'Too bad!' The President shook his head disappointedly. 'I thought he was a piano tuner. Oh, well, I reckon a doctor's jes' as good. Make out the appointment.'"

Those who disagree most widely with Secretary Work's policies voice the assertion that he was put into office for the purpose of discrediting reclamation. Some of the bitterest criticism against him comes from Republican members of Congress. "An attempt will be made," says Senator McNary, speaking of the coming session of Congress, "to ascertain from the Secretary why he has not worked upon the project heretofore authorized by Congress, and why he has left a story of sadness in all his speeches on irrigation."

In the meanwhile, the annual report of the Bureau of Reclamation, submitted in December, indicates substantial progress toward the correction of past mistakes in the fiscal policies of the department and the rehabilitation of the whole service. And Secretary Work himself, in a recent public statement, declares: "Both the Secretary of the Interior and the Commissioner of Reclamation have faith in reclamation by the government and are committed to its development, and determined to eliminate weakness in its policies and past practices."

Lawyers and Irrigationists Hold Varying Opinions on Pending Herminghaus Case

Statements on Involved Issues Quoted From Advocates of Both Sides and Neutral Sources

"NO SET of issues was ever more grossly misrepresented," declares John W. Preston, San Francisco attorney, "than the issues involved in the Herminghaus case." Mr. Preston is counsel for the plaintiff in this *cause celebre* of irrigation litigation, and naturally feels and speaks strongly on the matter, as will be seen in subsequent quotations; but whether or not he is correct in his assertion that the case is unique for the misrepresentation of the involved isues, at least none has attracted more wide-spread attention among irrigationists or been recognized as of more importance for the questions of water law involved.

The underlying facts in the case, as set forth in a memorandum prepared by Hankins & Hankins, attorneys for the Glenn-Colusa Irrigation District, are these:

"The plaintiffs in the action of Herminghaus vs. Southern California Edison Company are the owners of some 18,000 acres of land in the overflow basin of the San Joaquin Valley in California and riparian to the San Joaquin River. The defendant power company has built a dam in one of the different branches of the river, and desires to store the winter flood flow of water in a reservoir, to be released gradually and to be used for the creation of electric energy. The riparian land owners claim that their lands are overflowed in winter, and that this seasonal overflow produces pasturage and enriches the land by the deposit of sediment. Storage of flood waters, they contend, will prevent this overflow and thereby will injure their lands.

"The trial court found for the plaintiffs, deciding broadly that a riparian owner of lands could prevent the storage of winter flood water either by appropriators or riparian owners if such storage in any way interfered with any use of the water by lower riparian users. The question of the reasonableness of the use was not considered. An appeal has been taken from the decision to the Supreme Court of California and is now pending."

THE DISTRICT'S attorneys believe that such a theory as that embodied in the trial court's decision is "simply appalling" and that its logical carrying out would incalculably handicap further irrigation and hydro-electric developments in the state, sending California "back to covered-wagon days." This is their analysis of the issues involved:

"The development of irrigation in California has been retarded by the early adoption of the strict riparian theory as enunciated by the Supreme Court in the case of Lux vs. Haggin. In this case riparian rights were declared vested rights, and any appropriators of water were trespassers, their final right depending on whether they could use the water for five years before being discovered and stopped. Again in the Miller vs. Madera Canal case no regard was had to the reasonableness of a use of water. Once more it was held that a riparian owner could make only a slight or theoretical use of the water while the rest of the country, parched with thirst, must watch the water go by to be wasted in the ocean.

"A faint gleam of light was seen in the late case of Williams Irrigation District vs. Antioch, where the theory of the plaintiff, to the effect that a user of water in the lower reaches of the river could demand sufficient water to hold back salt water, was repudiated.

"The logical following out of the theory of the trial court in the Herminghaus case is simply appalling when we consider that all storage projects, on which practically all hydro-electric development depends, are placed at the mercy of the owner of a ten-acre tract of land on a river, overflowed once a year by a torrential stream. Although old projects may be protected by the statute of limitations, no one would dare to start a new storage project."

THE WHOLE riparian doctrine as it involves the water situation in California is brought into the lime-light by the issues raised in this case, declares William Durbrow, president of the Irrigation Districts' Association of the state, which has become sufficiently interested in the Herminghaus suit to instruct its own attorneys to file briefs and to appear as *amici curiae*. Mr. Durbrow states the attitude of the irrigation districts as follows:

"In spite of the theory of riparian rights as enunciated in Lux vs. Haggin, it would still appear that some reasonable ground could be taken by our courts, which would hold the riparian owner to the use of the water flowing by his land in accordance with practices that have been worked out and found reasonable throughout the western states. This means its proper diversion and its economical use, without which the continued growth of our agricultural activities becomes impossible. We have now arrived at a point in the state of California where we can see to the end of our water resources. To use our water that we may get the most out of it is absolutely essential to the growth and well-being of the State.

"Rights initiated by appropriation now provide for suitable hearings where all parties at interest may be heard and a proper check be put upon the use of the water so appropriated. This becomes impossible on diversion under the riparian doctrine under which the land owner has been making his own definition of use and of his relationship to his fellow users on the same stream. It seems fundamental that his right acquired under this doctrine should be construed strictly in accordance with the needs of a semi-arid country where the improvident use or the unregulated storage of water becomes a serious menace to the prosperity and growth of the commonwealth."

ONE of California's most eminent authorities on water-litigation is Dan Hadsell, of San Francisco. In response to a request for his opinion on the Herminghaus issues Mr. Hadsell replied with a statement in which he emphasized the value of the riparian principle, suggesting that there is but one limitation which may be safely applied to it. His opinion is:

"The Herminghaus Case, as I understand it, involves two questions in riparian rights, namely—(1) the extent to which a riparian owner on the stream may store water for future use, and (2) the extent to which a riparian owner may insist that the flow of the stream shall continue without diminishment by an appropriator above him.

"As concerns the first question. I do not know the facts in the Herminghaus Case and therefore I can only state what I think should be the principles that the court should apply. These principles are (a) there shall be no storage to the prejudice of a lower riparian owner; (b) there shall be no cyclic storage as against any lower riparian owner even though such storage is not directly injurious to such owner; (c) any water released from storage shall continue to belong to lower riparian owners as though such water had never been abstracted from the stream.

"The second question suggests a possible limitation upon the riparian right. I am in favor of only one limitation, namely—that the riparian landowner shall be entitled to have only such water from the stream as shall be necessary for the beneficial and economic irrigation of the whole of his irrigable riparian land. But I do not think that he should be robbed of this right, if he does not use it, by any attempt to deprive him of it, without compensation, by a statute which imposes a loss of his right simply because he has not used it. And even the additional right which the riparian owner now has, against appropriators above him, to insist upon the flow of the stream 'undiminished in quantity and unpolluted in quality' should not be taken from him except through condemnation and after price paid. The owner of riparian land has bought it because of its position on the stream and because of the riparian rights which the laws attach to such land. Morally as well as legally, the owner should be paid for whatever is taken from him by limitation. In consequence, no limitation should be put upon the riparian right by legislation such as Section XI of the Water Commission Act or by judicial decision such as some parties to the Herminghaus Case are seeking. And this conclusion must more forcibly apply to any limitation on the riparian right which is more

stringent than the one here suggested. I have long advocated that the state should condemn such parts of the riparian rights on every stream as are in excess of that limitation."

GLENN D. SMITH, president of the Mutual Water Companies' Association, also sounds a note of warning that the riparian theory ought not to be discarded—even if that is possible—without making sure that whatever principle is proposed to replace it would not be less perfect than the one now in effect. Better to bear the ills we have, he says, in effect, than to fly to those we know not of. We have had plenty of water litigation, he declares, and should be wary about any change that would increase it. His statement follows:

"The old Common law of riparian rights was adopted by the State of California more than sixty years ago, and I believe that lawyers who have given the question of changing that law careful study are of the opinion that the California Legislature is without authority to change it, as the abolishing of riparian rights would in effect be confiscation of vested rights. I think that it is very generally admitted that the riparian law has not provided the best method for appropriation and use of water for this state, but it is the law under which many valuable water rights were taken out, and by this I mean water rights the value of which is measured by the use to which the water has been put. This fact has been established and a change in that law should be approached with great caution. Assuming that a way may be found to change the present law, then that proposed method of appropriation and use of water should be referred to the different water interests of the state for consideration and suggestion, and certainly any new law would have to safeguard fully the present users of water.

"In any case, let us not do anything that will increase water litigation, for we have had quite enough of that. The Herminghaus case is merely incidental to the whole question, and if the Supreme Court sustains the injunction it will undoubtedly prevent the fullest use of some of the waters of California, which is regrettable, but until we give the Supreme Court some law other than that of riparian rights to guide it we should not complain of its decisions.

"I am not defending the law of riparian rights but until we find a sure and safe way out of it I suppose we will have to suffer from it.

"Possibly the litigating of the Herminghaus case may point the way to new equitable and safe methods of determining water rights. Changing the laws affecting water rights in this state is rather a momentous undertaking and must be viewed from many angles. The fullest development of the state as related to the fullest use of the waters, I believe, demands a change, but the welfare of the state demands that this be done with great care."

IN THE brief filed in the case by the Southern California Edison Company, the defendant stands upon its rights as a riparian owner, rather than following the tactics of the Irrigation Districts' Association in asking for a modified construction of the riparian doctrine. The contention is made that the company is merely exercising its proper rights as a riparian owner in storing water. Quotations *in extenso* from the brief are of course imposible, but the following headings from its topical index will give an idea of the issues upon which the defendant is basing its case and its appeal to the Supreme Court:

1. Edison Company has all the rights of a riparian owner. These rights are of two classes—one, the ownership in fee to certain lands riparian to Big Creek and Stevinson Creek; two, certain leasehold interests under licenses and permits from the United States, authorizing the occupancy of lands of the United States riparian to the river for power development.

2. The production of hydro-electric power is a proper subject of riparian use.

3. The reservoiring of water for future use by a riparian owner is a proper exercise of a riparian right and like every other use of water by a riparian owner is governed only by the reasonableness of such use in view of all of the surrounding circumstances and the rights of all parties.

BECAUSE of the general interest aroused by the pending Herminghaus Case, MODERN IRRIGATION has felt that a symposium of opinion from men conversant with the legal aspects of water development, on the issues of the suit, would be of value to its readers.

Opportunity for the expression of their views was afforded to both of the litigants, to the Irrigation Districts Association, as a party in interest, and to several of the leading land and power companies of the state. The accompanying article presents the varying views of spokesmen for both sides, and from parties who are interested in the development of a wise water law but have no direct concern in this particular litigation.—EDITOR.

4. The reservoiring of water is not inherently illegal or unreasonable.

5. The lower riparian owner must reasonably exercise his rights and must adopt suitable means to enjoy the same, and the mere fact that the use by the upper riparian owner causes some expense to the lower owner does not make such use (by the upper owner) illegal or unreasonable.

6. A riparian owner is not entitled as against another riparian owner to have the stream maintained so it will overflow his land.

7. The contention that plaintiffs are entitled to maintain the full flow of the stream to enable it to flow into the high water sloughs is unfounded.

(1) The inconvenience results from any use above and is due to an inherent infirmity in plaintiffs' situation, and the resulting damage is *damnum absque injuria.*

(2) Plaintiffs can avoid this result by constructing power works for the diversion of the water into the sloughs or otherwise onto their land.

8. Even if the riparian owner ever had the right asserted by the plaintiffs to the full flow of the stream as against another riparian owner desiring to reservoir and make beneficial use of the water, such right has lawfully and properly been taken away by legislation through a valid exercise of the power of the State to regulate the use of water between the joint owners thereof.

JOHN W. PRESTON, counsel for the plaintiff in the case, has submitted a statement in which he declares that "no set of issues was ever more grossly misrepresented" than those in the case under discussion, and he goes on to specify what those issues are. The following is quoted from his letter:

"We are not contending solely for the value to us of the overflow right in the San Joaquin River. We are contending that sixteen thousand acres of land will be entirely depleted of their water right if the power company is permitted to store in the manner proposed by them. In other words, we have numerous branch channels of the San Joaquin River traversing our lands. Some channels carry water when there are 2500 second feet in the river; some when there are 3500; some when there are 4000; some when there are 5000; some when there are 6000 and some when there are 8000 second feet in the river. All branch channels above 3000 second feet will be entirely depleted of their flow of water.

"All lands bordering upon these branch channels will, therefore, be dry and without the right to go to the low water channel for their water because the segregation line of the swamp and overflow title lands will cut these lands off of the low water channel and leave them entirely dependent upon dry branch channels for their riparian right. The acts and conduct of the power company will destroy absolutely the water right to sixteen thousand acres of valuable land.

"In addition to the above, it should be noted that the defendant has entered into contracts with Miller & Lux, Inc., in which contracts the power company admits it has no right to store water to any extent whatsoever except as the agent or licensee of Miller & Lux. This places the power company without the protection of the riparian right law.

"In addition to the above it should be noted that the defendant power company intends to store about seven hundred thousand acre feet of water, which is about seven-tenths of the entire flow of the stream between April fifteenth and July fifteenth of a normal year. The right thus to deplete the stream cannot be anything more than the claim of an appropriator and, of course, could not be held reasonable as to the riparian proprietors below who have an equal right to all the said waters.

"Furthermore, the power company has the San Joaquin River system tied up to its other systems upon various streams and also to its steam plants. It intends to store this water and discharge it according to the load demand upon its entire system, or when through emergency or failure of other systems it may become necessary to use the storage of the San Joaquin.

"In other words, the rights of the riparian owners below are entirely disregarded in the plan of the power company.

"Whether as a matter of policy it was unwise to adopt the riparian right law as we did by statute in this state seems to be a question foreclosed by the intervention of the rights of private property."

THE IRRIGATION DIGEST

A Monthly Bulletin Board of Brief Facts and Events from Far and Near

Five Million Dollar Project

The American River Hydro-Electric Company has filed articles of incorporation in California and has announced its proposal to spend $5,000,000 on a dam project at Folsom, California.

Agricultural Engineers Meet

The winter meeting of the Pacific Coast section of the American Society of Agricultural Engineers will be held December 18, at Davis, California. The main subject for discussion will be "The Place of the A. S. A. E. in Reclamation."

To Build Experimental Dam

Prominent engineers from many parts of the country gathered in Fresno, California, early in December, to perfect plans for the construction and breaking of an experimental dam on Stevenson Creek, tributary to the San Joaquin River. The dam will be destroyed in the experiments. It will cost $100,000.

Banta-Carbona Work Done

Twenty thousand acres near Tracy, California, have been opened to irrigation by the completion of the construction work on the Banta-Carbona irrigation project. The project has involved the expenditure of about a million dollars, during the past year, for a dredged channel, large pumping plant, canal and pipe lines.

Melones Construction Starts

Foundations for the Melones Dam, which will supply water to the Oakdale and South San Joaquin irrigation districts (California) have been completed and everything is in readiness for the pouring of the first concrete. Grading for the railroad has been finished, and rails were expected to be laid by the first of December.

Hoquiam Has Lots of Water

Hoquiam, Washington, has a bountiful supply of water assured as a result of the recent completion of a seven-mile pipe line from Davis Creek, supplying seven and one-half million gallons of water daily. The city has purchased 4000 acres of watershed lands on either side of the creek for the purpose of protecting the water supply.

Tumalo Fights Bend Diversion

The Tumalo (Deschutes) Irrigation District (Oregon) has served notice on the city of Bend that it will vigorously oppose any attempt on the part of the municipality to divert water from Tumalo Creek for domestic and muncipal use.

Seeks New Columbia Survey

C. C. Dill, U. S. Senator from Washington, has announced his intention of seeking authority from Congress for a survey and investigation of the Columbia River Irrigation project to be made by the senate committee on reclamation and irrigation next summer.

To Reclaim Million Acres

One million acres of land in the Yaqui Valley, on the west coast of Mexico, will be eventually reclaimed by plans now under way under the direction of the Richardson Construction Company, according to a statement from E. E. Richardson, president. Five million dollars have already been spent on this project, and 90,000 acres are now under cultivation.

Voters Endorse Relief Measure

Almost a unanimous vote was recorded by voters of the Boise-Kuna, Idaho, division of the Boise project at an election in November on the question of organizing into a district to obtain relief under the fact finders' bill. Of 772 votes cast, 745 voted in favor of the measure. J. A. Martin was elected a director from Precinct 1; Charles Thacker from Precinct 2, and George Oleson from Precinct 3.

Begin Concreting Canals

The work of lining with concrete 800,000 square yards of irrigation canals on the Salt River project has been commenced by the Salt River Valley Water Users' Association. The task will require about $750,000 for its completion, and will save 70,000 acre-feet of water in an ordinary year, according to reports from the Arizona project. The water saved by this means is to be used on the Roosevelt Conservation District.

Builds Private Dam

W. H. Detert, prominent land-owner of Middletown, California, is completing the construction of a dam at Gwenoc site in the Putah Creek watershed. The dam is thirty feet high and about 1000 feet long, and will impound water for the irrigation of 2,000 acres of Napa County land for alfalfa growing.

Form New Mexico District

By an overwhelming vote land owners of the Santa Cruz Valley, New Mexico, decided in November to form an irrigation district, which will embrace about 9,000 acres. The plan of the embryonic district is to build a reservoir in the Santa Cruz valley, above the town of Santa Cruz, at a cost of about $150,000, and to distribute the impounded waters through community ditch systems already constructed.

Form Montague District

Voting bonds to the amount of $1,395,000 for the installation of an irrigation system to water 19,500 acres of land surrounding Montague, Oregon, residents of that section in November recorded their intention to form a new irrigation district, of approximately the same acreage as the Grants Pass, Oregon, district. A dam will be built on the Shasta River, twenty miles from Montague, and a main canal 21 miles long, with 60 miles of lateral, will be constructed.

Propose New Plan for State

A bill proposing a change in the method of administration of irrigation districts will be introduced before the Washington state legislature, now in session, according to E. F. Banker, chairman of the irrigation committee of the lower house. The bill to be presented will propose the elimination of the office of state director of reclamation and in its place would establish a board consisting of the state land commissioner, state treasurer and state commissioner of agriculture. Reclamation would be under the control of this board, which would also be charged with the administration of the state reclamation funds.

Equipment Association Drafts New Pump Contract Form

November Meeting of W. I. E. A. Devoted Mainly to Consideration of Problems of Standard Guarantee

A standard form of pumping plant performance guarantee designed to prove acceptable to both manufacturer and consumer, looms as the most outstanding achievement of the November 20th meeting of the Western Irrigation Equipment Association, held in San Jose, California.

The executive committee of the association spent practically the entire morning in discussing the proposed standard guarantee with the California Committee on the Relation of Electricity to Agriculture. Several minor changes were made in the form of the document, and it was then pronounced ready for presentation to the membership of the association in the open afternoon session.

Here many more comments and suggestions were offered, and at last a draft that is considered practically certain to prove acceptable to all interests was evolved. As is the custom of this organization, however, the final adoption by vote of the membership was withheld until the Los Angeles meeting, slated for January 22nd, 1926. It is taken for granted that by that time representative manufacturers, dealers and irrigators will have had ample opportunity to weigh the proposed form, and decide their attitude toward it.

The November meeting, which recorded the largest attendance of any session of this body to date, was declared a success from every standpoint. At the banquet held in the Vendome Hotel, Friday evening, Joe Cox presided as toastmaster, and a number of interesting discourses were presented. Of especial value was an informative address on the new cotton industry of California. The speaker, J. Bradley Clayton, laid special stress on its tie-up with the irrigation equipment industry.

On the day preceding the regular association meeting, the pump manufacturers held an informal gathering at which the advisability of forming an organization of manufacturers of this type of equipment was considered. A temporary chairman, Robert Sherman, with C. A. Utley as temporary secretary, was appointed, with a view to giving the plan further consideration and reporting at a meeting to be held in the near future.

The exact form the organization will take, if it is formed, has not yet been decided. It may be conducted as a branch of the Western Irrigation Equipment Association.

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IRRIGATION MANAGEMENT

ALKALI DANGEROUS ON HIGH-WATER TABLE

ONE of the most important problems of the citrus and walnut grower is that of the effect of alkali on citrus and walnut trees, says Vincent Blanchard, farm advisor of Ventura County, California, in a recently issued Farm Bureau publication.

There are at least three different conditions in which alkali salts are found, says Mr. Blanchard. First, where alkali is present in the soil due to a rise in the water table. Second, where irrigation water is used that has a high salt concentration, and third, where the concentration of salts in the soil increases due to the failure of rainfall in being sufficient to distribute the salts by leaching.

The grower of citrus and walnut trees on soil which has a high water table has a real problem to face. Citrus and walnut trees are exceedingly sensitive to the effects of alkali salts.

ACCORDING to Dr. W. P. Kelley of the Citrus Experiment Station, who has had charge of the alkali investigations for the College of Agriculture of the University of California, walnut trees are so sensitive to the efects of alkali salts that if lower roots reach the high point of concentration near the water table the trees show the effects in the tops even though the salt concentration might be very low in the upper few feet. It is therefore, hazardous to plant walnut trees on high water table land.

Citrus trees, being more shallow rooted, might do better on such land than walnuts providing there is adequate drainage, so that the water table will not rise. It is particularly dangerous to plant trees on such land unless this drainage is provided as the time will come when we will have heavy rainfall with its effect on increasing the height of the water table.

Those orchards which are being irrigated with irrigation water with a high salt content can be corrected only with the securing of a better supply of water.

RECENTLY Dr. Kelly called all of the Farm Advisors of Southern California to a conference at Riverside on the effects of alkali on citrus and walnut trees. He showed the Farm Advisors citrus orchards in the Riverside district which had both salty water and pure water. He pointed out orchards which were at one time considered the very finest in the state and which today are in an exceedingly poor condition. The tops are smaller, the foliage chloratic and mottled and the fruit production is very low. Other orchards with good irrigating water alongside of these are in a healthy condition and produce profitable crops. It was pointed out by Dr. Kelly that the poor results have not come all at once but extended over a period of several years. As the citrus plantings in the Riverside district increased, the gravity water from the mountains became insufficient to meet their needs; therefore, wells were drilled to supplement the gravity water. Those orchards irrigated from several of the wells show the effects of salt injury.

Two walnut orchards were observed with the salty water and the other with a pure water from the mountains. The walnut trees with the salty water were practically dead while the others were in a healthy condition.

ONE orchard was observed which, at one time, showed good foliage and a healthy growth. With the development of irrigation water from a well on that property 50 per cent of the trees actually were dead and most of the remaining trees were almost dead. Another orchard was shown the Farm Advisors to which Dr. Kelly was called several years ago to try to determine the cause of its decline. Dr. Kelly found that the irrigation water showed a very high salt content. He therefore advised the grower to develop a better supply of water, which advice the grower carried out. With the use of better water this particular orchard has recovered and is growing profitable crops.

The third condition under which alkali salts are injurious to citrus and walnut trees is where the salts have become concentrated as a result of several years of drought. This has been particularly noticeable in some sections during the past two years and to a great extent this year. On walnut trees the effect is apparent with the browning of the edges of the leaves and premature dropping. It would be advisable in such cases for the growers to try to distribute the salts through the soil by basin irrigation with the application of a considerable amount of water. Perhaps one irrigation with such a method, even though large quantities of water are applied, does not accomplish this distribution of salts as the salts tend to rise and accumulate near the surface.

President's Message Deals with Problems of Reclamation

Colorado River Development, State Aid in Settlement of Projects, Urged by Coolidge Before Congress

The President's annual message to Congress, read before the joint session of the two houses December 8th, touched upon reclamation and the development of the Colorado River as two of the major problems before the nation.

Reviewing briefly the condition of federal reclamation, President Coolidge suggested that co-operation should be required from the state in the "intimate, detailed and difficult work of securing settlers and developing farms." On the subject of reclamation, he said, in part:

"The national government is committed to a policy of reclamation and irrigation which it desires to establish on a sound basis and continue in the interest of the localities concerned. Exhaustive studies have recently been made of Federal reclamation, which have resulted in improving the projects and adjusting many difficulties. About one-third of the projects is in good financial condition, another third can probably be made profitable, while the other third is under unfavorable conditions.

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"The Congress already has provided for a survey which will soon be embodied in a report, that ought to suggest a method of relief which will make unnecessary further appeals to the Congress. Unless this can be done, Federal reclamation will be considerably retarded. With the greatly increased cost of construction and operation, it has become necessary to plan in advance, by community organization and selective agriculture, methods sufficient to repay these increasing outlays."

A recommendation for a policy of state co-operation in solving the problems of settlement, which has been urged by the present heads of the Reclamation Bureau, is contained in the President's message:

"The human and economic interests of the farmer citizens suggest that the States should be required to exert some effort and assume some responsibility, especially in the intimate, detailed and difficult work of securing settlers and developing farms which directly profit them, but only indirectly and remotely can reimburse the nation.

"It is believed that the Federal government should continue to be the agency for planning and constructing the great undertakings needed to regulate and bring into use the rivers of the West, many of which are interstate in character, but the detailed work of creating agricultural communities and a rural civilization on the land made ready for reclamation ought to be either transferred to the State in its entirety or made a co-operative effort of the State and Federal government."

TURNING to the question of the Colorado River, the message said, in part:

"Preliminary measures are being taken on the Colorado River project, which is exceedingly important for flood control, irrigation, power development and water supply to the area concerned. It would seem to be very doubtful, however, whether it is practical to secure affirmative action of the Congress, except under a joint agreement of the several States.

"The government has already expended large sums upon scientific research and engineering investigation in promotion of this Colorado River project. The actual progress has been retarded for many years by differences among the seven States in the basin over their relative water rights and among different groups as to methods."

The history of the Colorado River Compact was then briefly traced, and the message continued:

"It is imperative that flood control be undertaken for California and Arizona, preparation made for irrigation, for power and for domestic water.

"Some or all of these questions are combined in every proposed development. The Federal government is interested in some of these phases, State governments and municipalities and irrigation districts in others, and private corporations in still others. Because of all this difference of view it is most desirable that Congress should consider the creation of some agency that will be able to determine methods of improvement solely upon economic and engineering facts, that would be authorized to negotiate and settle, subject to the approval of Congress, the participation, rights and obligations of each group in any particular works. Only by some such method can early construction be secured."

Importance of Water Titles Explained by Mr. Bryan

(*Continued from Page 14*)

uncertain status of old appropriative rights initiated prior to the effective date of the Water Commission Act, order should long since have evolved out of chaos in the matter of water titles.

WHILE the present situation is much improved, over that of years past, it is not yet one of such certainty as is desirable. Many old appropriative rights are not even recorded and are based purely upon beneficial use. Many of the old appropriative claims which were posted and subsequently filed in the offices of the County Recorders have never been consummated, or, if consummated wholly or in part, have since been partially or wholly abandoned. We have the developments already made under an unrecorded claim of riparian right, and we have also the claim of riparian right for proposed future developments, which claim is now denied by the provisions of Section 11 of the Water Commission Act as noted above. And we have the developments which have proceeded by appropriation under the provisions of the Water Commission Act, in which cases the priority is clearly defined as is also the amount, place, and manner of use and the source and point of diversion. This last class of water rights is the only one which is accurately recorded, and where title is promptly and effectively forfeited in accordance with the statute when the right is forfeited by non-use.

The Water Commission Act provides that upon its own motion or the request of one or more users of water from a stream, the Division of Water Rights may undertake an adjudication of the *appropriative* rights to divert therefrom. The Act further provides that where suit has been brought involving the use of water from a stream the Division of Water Rights may, through reference by the court, undertake a determination of all the rights, *riparian as well as appropriative,* upon the stream.

Where work of this character is undertaken, the Division establishes the relation of the various claims of right by means of field surveys and investigations, examination of records, and the proofs which are required from the several claimants. Its findings, when confirmed, or as modified by the court, clearly fix the extent and relations of the various rights involved.

The Water Commission Act provides also that in those cases where the various water rights upon a stream have been determined the Division of Water Rights may—upon request of the water users—appoint a water master to administer said stream and to see that the waters thereof are distributed to the various claimants in accordance with their established rights. Prior to any formal determination of rights the Division has been enabled also, by agreement among the various claimants of right, to appoint a watermaster to distribute the waters of Kings River, Shasta River, Burney, Owl and Soldier Creeks.

THE KINGS RIVER case is a most interesting one. Here was a stream of some 1,900,000 acre feet mean annual discharge supporting an irrigated agricultural development of 650,000 acres. After years of litigation, resulting in many conflicting court decrees, the various claimants in 1917 requested the co-operation of the State Water Commission, predecessor of the Division of Water Rights. An engineer of that office for four years obtained daily records of stream flow and diversions. With this data as a basis, the Division in 1921 prepared a schedule of distribution of water. By agreement among the water users this schedule has since been enforced without friction, and a way is being prepared for the construction and operation of storage works.

Confusion in the matter of water rights, threatened litigation, and an impending water shortage on Sacramento River created a similar desire for co-operation on that stream early in 1924. A "water supervisor" was appointed by the Division of Water Rights to effect such economies as were possible in the use of water and to assemble accurate data concerning stream flow and diversions in Sacramento Valley and the Sacramento-San Joaquin River Delta. This work was financed principally by local subscription in 1924, but the legislature has provided funds for a continuation of the work in 1925 and 1926.

The Division is carrying on a somewhat similar investigation on San Gabriel River in Los Angeles County. This is being supported almost entirely by local subscriptions.

SUCH WORK has an importance that cannot be over-emphasized. California has passed through those early stages of development of its water resources when those who would could help themselves to the waters of her streams. There is no longer an abundance of water from which all may help themselves. There are few streams in the state on which the total low flow is not already appropriated—perhaps over-appropriated. The construction of vast storage works now makes an accurate determination of even the flood flow rights of vital importance.

We may, without forethought and foresight, let matters take the course which they did on Kings River prior to 1917 and which they were taking on Sacramento River prior to 1924. Tediously, haltingly, and at terrific expense, the relation of the rights of the various claimants may be worked out by litigation. Calmly and expeditiously and with nominal expense the same problem may be worked out through physical investigation by impartial experts. It is interesting to note, in passing, that the annual cost of the investigation on Kings River has averaged about 1½ cents per acre affected while the Sacramento-San Joaquin Water Supervisor work is averaging approximately 4½ cents per acre per year.

The ultimate objective of all water legislation and administrative effort is the distribution of the water itself to those who have a valid claim upon it. This object cannot be accomplished while water titles are in doubt. We now have a positive method of initiating new rights but further development of California's water resources must be uncertain and slow so long as there is uncertainty concerning existing rights. The conflicting theories of appropriation and riparian right make it difficult to clear up this uncertainty. Three courses are open to accomplish this end. One is by litigation. A second is through the code provisions of Sections 24 to 36f, inclusive, of the Water Commission Act. The third is through such investigations described above as are now in progress on Kings River, Sacramento and San Joaquin Rivers, and San Gabriel River. The readiness with which development proceeds will depend largely upon the success with which litigation is avoided and rights determined by physical investigation and the collection of run-off and diversion records.

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HYDRAULIC ENGINEERING

Dealing with the Practical Problems of the Operating and the Consulting Engineer

DRAINAGE PROBLEMS OF THE LOWER RIO GRANDE

By CHARLES P. WILLIAMS
Consulting Engineer

THE LOWER RIO GRANDE Valley, for a distance of about one hundred miles from the Gulf of Mexico, has the geological formation of a river delta. Repeatedly, the river has changed its course, departing from its channel along the crest of the ridge formed by alluvial deposit during overflow, and building a new channel in some lower part of the delta region. An old channel having its ends soon filled by deposits of sand and silt from the river became a lake, in some cases of considerable length, in others relatively short and of horse-shoe shape. Such a channel, when of considerable length, is known, in this section, as a resaca, and one resulting from the river cutting thru the neck of a horse-shoe shaped bend, as an estero.

At the time of overflow, the river water is heavily laden with sand, silt, and finely triturated clay. These are held in suspension by the turbulent and swiftly moving water in the river. When overflow occurs the velocity of the outflowing water is reduced by the decreased depth of the sheet of water and by the retarding effect of the brush and other vegetation, through and over which the flowing water must pass. The reduction in velocity results in the deposit of the sand, silt and clay, carried in suspension. The coarser and more pervious materials are deposited nearest the river. The less coarse materials are carried farther and are deposited in the reverse order of their finess.

NOT only the coarser, but also the larger part of the materials carried in suspension by the river water is deposited near the river. The lands near the river thus become higher than the more distant lands. It results, therefore, that the higher lands along the resacas, or the ridges which mark the location of obliterated resacas, have more sandy and relatively pervious soils, while the lower intermediate basins between the resacas have have dense and impervious clay soils.

Owing to the irregular topography of the land over which overflow occurs, and the irrigular character and distribution of the vegetation which retards the flow, the depth and character of the deposited materials are very irregular. The strips of land along the resacas and ridges, having sandy loam or silty clay loam soils, vary in width from a few hundred feet to half a mile or more. Sand and other soil strata are found in some places continuous for a considerable area and in other places in isolated pockets or lenses.

THE LANDS of the Delta have topography shaped principally by flood deposits and but little by erosion. The natural surface drainage is therefore toward comparatively small closed depressions. The resacas of more recent geologic formation, while having, for short distances, channels of considerable capacity, are disconnected, and moreover are situated along the higher areas. For only very narrow strips of adjacent land is there natural surface drainage toward a resaca. With only one exception, the Arroyo Colorado, is there free natural drainage outlet to the Gulf. There is therefore practically no natural surface drainage for the large area of delta lands. Any surplus rainfall and water applied in irrigation, above that required for plant growth, must either be evaporated or must sink into the subsoil, contributing to the rise of ground water.

Delta lands in general have a slope toward the Gulf of only about two feet to the mile. The velocity of the underflow must be therefore extremely low and the underflow must offer but little assistance in the disposal of excess subsoil water.

In the Delta lands the amount of alkali salts within the root zone is ordinarily not excessive, unless concentrated in the upper soil by excessive evaporation due to high water-table. The lower soils of the Delta, to some extent at least, were deposited in seawater and therefore impregnated with sea-salt. In the Brownsville area sodium chloride (common salt) and calcium chloride, both very destructive to vegetation, predominate. Sodium carbonate, commonly known as black alkali, does not occur in appreciable quantities.

Although the average rain-fall of the Delta region is no more than that required for plant growth during the long growing season, its distribution is very erratic. The annual rainfall in the irrigated region has ranged from 12 to 60 inches. Frequently, however, the greater part of the annual rainfall occurs in a single month, or even in a single storm. A precipitation of 5 inches in 24 hours is not uncommon, and two inches in 24 hours is of frequent occurrence. Due to the lack of surface drainage, the greater part of the water falling during these torrential storms must either evaporate or sink into the subsoil, thus contributing greatly to subsoil water.

NECESSARILY the principal canals of the irrigation system in the Delta must be located along higher lands in the irrigated area. These lands, particularly along the immediate crest of the ridges, have the most permeable soils of any of the Delta lands. The seepage from the canals is therefore greater than if the canals could be constructed in the more impermeable soils. During the earlier construction period, resacas, where available, were used as main canals. In their use as reservoirs, and in order to provide irrigation for lands immediately adjacent, the resacas were kept bank-full. While the river silt deposited in the resaca bottoms undoubtedly reduced greatly seepage losses therefrom, the upper portions of the banks remained very porous and the water lost through seepage contributed

This discussion of factors which affect the water situation in the Lower Rio Grande Valley and make drainage a difficult problem is reprinted from a much longer and more exhaustive treatment of the subject by the author in the Gravity Irrigation News, published in McAllen, Texas, by the Lower Rio Grande Valley Water Users' Association.

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greatly to the sub-soil water and to the concentration of injurious salts in the surface soil. In some of the irrigation projects, unusually large main canals were constructed, in order that they might serve as equalizing reservoirs. Although the permeability of these large canals undoubtedly has been greatly reduced by silt deposit, due to extremely slow velocities of the water flowing through them, the seepage losses probably exceed the losses of canals usually built for serving similar areas.

BUT LITTLE data are available for determining the amounts of water per acre delivered at the land, in irrigation in the Delta. There is no doubt that the quantity used in many cases is excessive. The writer has been informed by ditch riders that, to their positive knowledge, amounts ranging between one foot and one and one-half feet in depth have been used in a single irrigation. The methods used by the farmer in applying water are, in many cases, not such as result in the greatest economy. The prevalent custom of charging for water a certain amount per acre per irrigation is conducive to waste. Surplus water used sinks into the ground, causes a rise in the ground water, and results in increased cost to the farming community by hastening the need for drainage and by increasing the extent of works needed.

On some projects many canals are kept full of water when little or no water is being delivered therefrom. Canal losses are nearly proportional to the time water is kept in canals. In many cases water is kept at a higher elevation in canals than necessary for making deliveries. Canal losses are increased by increased depth of water.

THE REQUIREMENTS for subsoil drainage becomes more pronounced as the lower end of the Delta is approached. In the westerly end of the Delta, the water is generally not dangerously near the ground surface, except immediately adjacent to canals. Borings made in the Pharr-San Juan District indicate a water-table generally ten feet or more below the ground surface, except for areas about 100 feet in width along canals. In some places the ground-water was found to be from 20 to 30 feet below the ground surface. Along the canals, however, in the greater part of the area investigated, the ground-water was very near the ground surface and canal borrow-pits in most places were full of water. In the El Jardin District, at the lower end of the Delta, ground-water is usually found at depths of five feet or less below the surface, and there are only a few comparatively small areas where it is not dangerously near the surface. In that district it appears that excessive evaporation takes place from the silty soils along the resacas, when the depth of the water-table is about six feet. It is understood that the ground-water is dangerously high in many parts of the San Benito and Harlingen Districts. It is known to be high in certain parts of the La Feria district, in some cases within three feet of the ground surface.

Even in the westerly part of the Delta region, where the general level of the ground-water now is at a safe distance below the surface, its continued rise may be expected, and eventually sub-soil drainage will be necessary if the productivity of the soil is to be maintained. The construction now of intercepting drains along the canals probably will offer sufficient protection for most of the lands in the upper delta region for some time to come. Large areas in the lower delta region now require complete sub-soil drainage, if their productivity is to be maintained.

Big Exchequer Dam of Merced District Now Three-Fourths Completed

Remarkable progress has been made by the Merced Irrigation District in its big task of building the Exchequer dam and power-house and in re-locating 17 miles of the Yosemite Valley Railroad that at present runs through the reservoir site. The dam is already 78 per cent completed, and Bent Bros., the contractors, expect to finish both the dam and the power-house next February. Ten miles of the substitute railroad has been laid. Only five per cent of the excavation work on the roadbed and cuts of the entire line remains to be done. Bridge and tunnel work for the railroad is well advanced.

This announcement has been made by the managers of the syndicate of twelve California bond houses that underwrote the $9,010,000 six per cent bonds issued by the district last year to finance completion of its irrigation-hydro-electric project in the San Joaquin Valley.

The Exchequer dam has been pushed far ahead of schedule, the financial houses report. There is in place a total of 310,000 yards of concrete, and it will require only about 60,000 yards more to complete the dam and the spillways. Openings which have been left in the dam for passage of the winter floods will be closed, it is anticipated, about March 15 next. At that time the relocated railroad will be placed in operation.

Construction of the power-house is also well ahead of schedule. The valves, penstocks and waterwheels have already been installed. Nearly all the electrical equipment is on the ground, and delivery of the rest within a short time is expected.

R. V. Meikle and Ross White, the engineers in charge, anticipate putting the power-house into actual operation before May 1, 1926. This date is appreciably earlier than had been originally thought practicable. In addition, the power-house will have greater efficiency than was contemplated last year, by reason of the installation of improved models of machinery. The power output has been sold in advance, under long-term contract, to the San Joaquin Light & Power Corporation, at 4 1-2 mills per kilowatt hour.

The substitute railroad—itself a work of considerable magnitude for an irrigation district, costing approximately $4,000,000—entails among other matters the building of a number of bridges and tunnels. The ten miles completed consists of a 7-mile length beyond Merced Falls (including No. 1 steel bridge, two trestles and No. 1 concrete-lined tunnel), and a 3-mile length from No. 4 steel bridge to Detwiler.

Grading work will probably be finished by December 1, 1925. The railroad contractor will then have only the concrete lining of No. 3 tunnel and the excavation and lining of No. 4 tunnel to complete his contract. Wet weather will not interfere with this tunnel work, as the material for the concrete lining will be brought in over the new railroad.

By December 1, the American Bridge Company will start on the big bridge across the Merced River, estimated to take 90 days to build.

Irrigation 'Round the World

(*Continued from Page 12*)

great war taught all peoples the wisdom of producing certain of the necessities of existence as near home as possible. England, for example, is endeavoring to become independent in the cotton market; Spain is developing water power and is improving old irrigation facilities to save coal and be independent of shipping; France is likewise interesting herself in water power; Italy and even the smaller nations are planning both irrigation and water power. In regions where irrigation is profitable, water power developments are nearly

always associated nowadays with irrigation developments.

In the Western Hemisphere, however, irrigation activities have been intentions rather than achievements in the years since the war. In the United States the realization has at last been forced upon the country that the plan under which the governmental activities were carried out would not work. This has caused the nation to stop and take stock. Very little new work has been undertaken. While the troubles have been largely associated with the projects of the Reclamation Service, the general effect has been the same with all classes of irrigation institutions. An account of what has happened in this country can not be given here, for it is a story, and an interersting one, in itself. Outside of California there has been very little new irrigation work since the armistice.

MEXICO, that country with such wonderful possibilities in irrigation, is a country where there has been a great deal planned—but little done in a constructive way. Mexico is going through a complete reorganization politically and until there is evidence of stability and a willingness to encourage the investment of foreign capital, there is little hope for many of the large projects planned. Mexico has some of the richest opportunities of any nation. Its west coast has been described as the equivalent of California in the 60's. It is a region with a superb climate, capable of producing all sorts of crops,—winter tomatoes, sugar cane, cotton, lemons, oranges, or wheat if you like,—lying closer to the center of American population than California. If the Mexicans encourage foreign capital, we may expect to see these coastal planes filled with irrigation canals.

In South America there is much talk of the development of irrigation works. All down the west coast new plans are being talked of, but for lack of confident capital there is very little large work being undertaken. In Argentine new works are under construction and land is selling at present as high as a thousand dollars an acre.

Canada has gone through very much the same irrigation history as parts of the United States,—the inability of the owners of irrigation enterprises to make the ventures pay in the face of changed conditions since the war. In this respect irrigation does not differ from the building of railroads or many other large industries. Reorganizations are being effected and we may expect to see the business go on and finally reach the goal of financial success.

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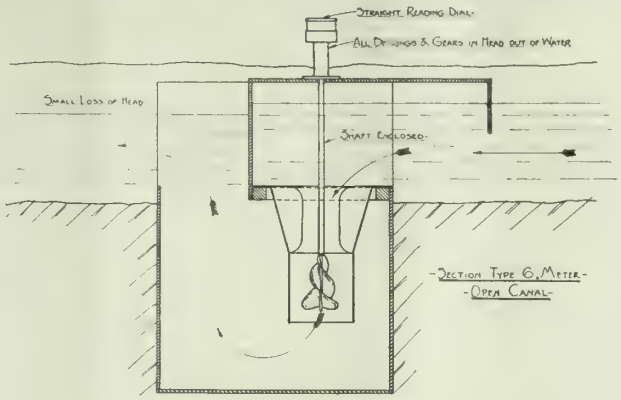
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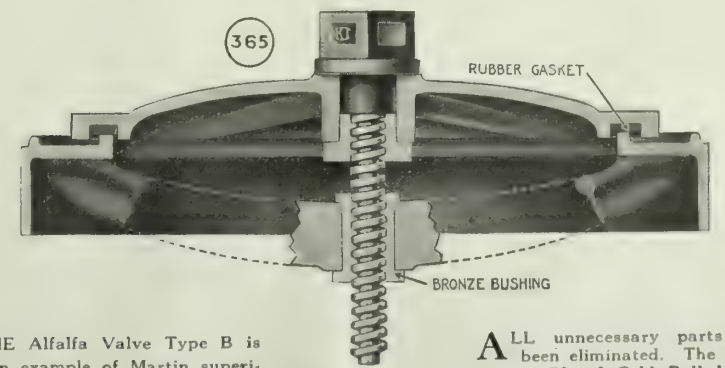

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WITH THE WATER COMPANIES

Of Interest Expressly to Water Works Engineers, Superintendents and General Managers

PRINCIPLES OF PUBLIC-UTILITY WATER RATE FIXING

By M. R. MacKALL

Hydraulic Engineer
State Railroad Commission
State of California

A PUBLIC utility water company operating in California may, at any time, file with the State Railroad Commission an application for an increase in rates, which can only be granted by formal order after the holding of a hearing open to the public. A request by a utility for a reduction in rates may be granted informally by the Commission without a public hearing, provided no discrimination results. As the reader may suspect, however, this removal of complications has not resulted in an epidemic of requests for lower rates.

The time required to render a final decision in a rate proceeding varies from one month to one year from date of filing, depending upon the size of the plant and the amount of work pending before the Hydraulic Division for investigation. It should be remembered that all affairs and complaints involving every public utility water system in the state are conducted by a department composed of but seven engineers. This is quite a task when it is considered that there are 431 public utility water companies in this state.

The matter of rate fixing and public utility valuation is highly complicated and involved and has an almost unending variety of problems peculiar to each individual case, many of them not as yet definitely settled by law or even practice.

WHEN application is made by a utility for rate adjustment a complete inventory of the entire properties should be submitted at the same time. If the size of the plant and the financial conditions of the company warrant, this inventory, as well as an appraisement of the properties, should be prepared under the direction of a competent engineer familiar with valuation matters. The engineers from the Commission, after checking the inventory, prepare a report giving an independent valuation of the properties and containing an analysis of the costs of maintenance and operation during the past for the purpose of determining the reasonable and proper expenses for the future. The report of the engineers of the Commission must be substantiated by the evidence and subject to cross-examination exactly as any other matters presented to the Commission.

The Commission has generally, in the past, adhered to the principle that valuations for rate fixing purposes should be based upon the reasonable historical or original cost of the investment in the physical properties which are being devoted to the public use at the time of the proceeding. Lands and rights of way, however, are appraised at the present market value. Consideration also is given by the Commission to the present value of the plant as determined by the reproduction cost of the properties less accrued depreciation. It is perhaps advisable therefore, especially from the standpoint of future financing, for any utility contemplating an application for an increase in rates before the Commission to present both an estimate of the value of the properties based upon the historical or original cost and upon the reproduction cost theory less accrued depreciation.

IN ARRIVING at a fair value for rate fixing purposes the Commission will exclude non-operative lands, structures and equipment. Intangible values such as going concern, development costs, working capital and water rights are also elements which must be given proper consideration. Thereafter, if conditions so warrant, a schedule of rates is designed to yield the utility a fair return upon its investment over and above the reasonable cost of operation, maintenance and depreciation. While a fair return under normal conditions is taken by this Railroad Commission at approximately 8 per cent in ordinary utility practice, yet the Supreme Court of the United States has frequently held that a return of 6 per cent may at times properly be held a fair return and will not amount to a confiscation of the properties of the company without due process of the law.

There are, of course, a great many exceptions to the granting of a full return upon the rate base as found. For instance, it frequently happens that in order to produce a fair return upon the investment a rate would be required which would be so high as to be prohibitive. Unfortunately this situation is by no means rare in the state of California, especially so far as water utilities are concerned. We have a great number of water companies which have been installed by real estate concerns primarily for the purpose of aiding in the sale of lots. When the real estate operations on many of these subdivisions have arrived at the point where they are no longer lucrative, the operator, if he cannot find a victim to relieve him of his public utility burdens, is required to continue the operation of his plant until such time as the territory develops to the extent where a fair return can be realized through a reasonable rate. There are many water systems starting out which are still in a development stage, and in justice to the consumers served by them are not yet entitled to a full return upon the capital invested. There are a great number of irrigation and domestic water concerns which have been the outgrowth of the old mining ditch systems of the early days where the territory served, formerly supporting flourishing communities, is reduced to the extent that the company is unable to meet bare operating costs.

The right of the Commission to fix a rate under these circumstances at a figure less than that which would give a full return upon investment, was recently questioned by one of the power companies in the southern part of the state, which took exception to the ruling of the Commission that the territory served was in a state of development. This matter was taken into the federal courts in California, and while dismissed, re-

sulting in a victory to that extent by the Commission, the dismissal was, nevertheless, upon a technicality and the real point at issue has not been settled by the United States Supreme Court.

A DECISION by the courts precluding any regulatory body from using its discretionary power in the fixing of rates would be a calamity and a death blow to public utility regulation. Any system of regulation, whether by courts or administrative bodies, which disregards the great economic principle that there is a limit beyond which the value of the service rendered can not go, is doomed to failure. Although the position of this company was primarily that of questioning certain findings of the Commission to the extent that the rate fixed was actually all that the traffic would bear, and while this company perhaps did not insist that the Commission should be deprived of all discretion in matters of rate fixing, the principle involved was, nevertheless unescapable, and if carried to its logical conclusion would result in the regulation of rates purely by mathematical formula.

The Commission has, in the designing of rate schedules, tried various methods of determining the charges to be paid thereunder. For a water company the fundamental need is to have a proper amount of money returned to it each year by way of revenues .It is, theoretically, at last, interested but interested in the manner in which these rates are spread among its consumers. Although the Commission has tried scientifically designed rate schedules, wherein it was necessary to depart from time-honored practice, such changes have created such storms of protest as to make the practical application of such rates hardly worth while. The Commission has, therefore, quite uniformly adhered to the simplest and most readily understood forms of rate structures.

The Commission has expreienced a considerable handicap in rate fixing by that custom of the early days in which the cities, in granting a franchise to a water company, would require that all water served to the city itself, including fire service, should be free. Investigations by the California Railroad Commission, as well as the investigations conducted by other regulatory bodies, have determined that the actual cost of investment for the delivery of water for adequate fire fighting purposes runs from 25 to 75 per cent of the entire plant investment. The cost of maintenance and operation of the system is increased proportionately.

The difficulty here, of course, lies in the fact that in order to deliver a large volume of water in a short period of time a greater capacity of distribution and transmission mains, as well as storage and standby equipment, is required than would be necessary for normal domestic service. This Commission, adopted at an early stage, the principle that free municipal service was unfair and discriminatory and should be abolished, and proceeded to fix rates to be charged municipalities for fire service, sewer flushing, and for other municipal purposes, upon the theory that the entire cost of operating and maintaining the additional investment required for these municipal functions should not be placed upon the shoulders of the regular consumers but should be paid for by the property owners who directly benefit thereby. While this principle was unpopular among city officials, who were more vitally interested in a lower tax rate than in equalizing the consumers' burden, nevertheless its fairness and reasonableness soon commended itself even to the municipal authorities, and the practice is now firmly established.

Newport Beach Lets Contracts for New Water System

Contracts that will total $280,000 were let in November by the Board of Trustees of Newport Beach, California, for the construction of an entire new domestic water system for the city. Leer Weber of Santa Monica was awarded the contract for most of the work, consisting of laying many miles of iron pipe line. His bid totaled $157,545.60.

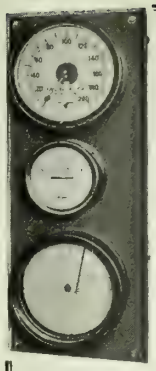
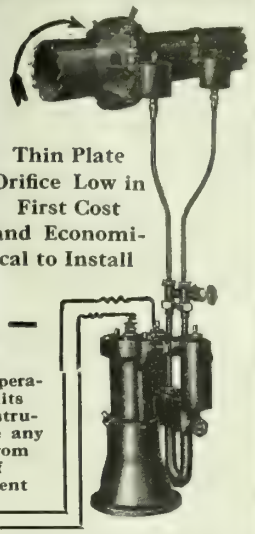
The Chicago Bridge and Iron Company of Chicago was awarded the contract for a 50,000-gallon elevated steel tank at $5275.00.

The Pacific Tank and Pipe Company, Los Angeles, was awarded the contract for laying all-wood stave pipe lines for $61,246.77. Stroud Brothers and Seabrook, Vista, Cal., got the contract for trenching and backfilling, for $6338.50.

Bonds of $350,000 were voted by Newport Beach in September for the water system. It is designed to serve a community of 50,000 persons and is believed to be ample for the next twenty years.

Buys Water Land and Wells

Anaheim, California, is believed to have settled the problem of its domestic water supply for several years to come by the recent purchase, for a consideration of $25,000, of two acres of land within the city limits, which contain two deep water wells equipped to pump a maximum of 5,000,000 gallons per day.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WHO'S *WHO* AND WHO'S *WHERE*

IN IRRIGATION AND RECLAMATION

Personal Notes and Impersonal Observations About Men You Know

Paul S. Jones, who has been identified with water development in the Imperial Valley for many years past, has been appointed general manager of the Palo Verde Irrigation District.

A. L. Christiansen, county agent for the agricultural extension service in Tooele County, Utah, has been transferred to Weber County, and Lyman H. Rich has been appointed county agent in Wasatch County.

Two directors were named by the Central Oregon Irrigation District at its annual election in November. G. N. Dorn was named for a three-year term, and Frank N. Davis was chosen to fill the unexpired term of W. Van Allen.

Joe Jacob, incumbent, and R. S. Short were elected in November as directors of the Klamath, Oregon, Irrigation District. They were opposed by Charles E. Drew and G.H. Carleton. Their election followed a hot political fight.

A. C. Finney, state assemblyman from Imperial County, has been appointed associate counsel for the Imperial Irrigation District. He will assist Chief Counsel Charles L. Childers, who expects to spend much of his time during the next few months in Washington.

Rhea Luper, state engineer of Oregon, has been delegated by Governor Pierce to attend a conference in Washington, D. C., on December 14 and 15, called by Commissioner of Reclamation Elwood Mead to consider problems faced by the Bureau of Reclamation in the western and southern states.

Jay H. Upton, Oregon state senator, has announced his candidacy for governor of the state. Mr. Upton is an active irrigationtist, having served two terms as president of the Oregon Irrigation Congress. He has been prominently identified, during his legislative career, with irrigation legislation in Oregon.

Samuel Kahn, for the past twelve years vice-president and general manager of the Western States Gas & Electric Company, Stockton, California, has been elected vice-president and director of the Market Street Railway, San Francisco. He becomes general manager of the company as well.

William G. Talbot, of Los Angeles, general manager of the Los Angeles plant of the Western Pipe & Steel Company, died suddenly, following an operation early in December. Mr. Talbot was a prominent figure in business and club life of southern California, and one of the heads of an organization intimately connected with the construction side of irrigation.

The Deschutes, Oregon, Irrigation District, commonly known as the Tumalo, elected W. R. Gerking and C. M. Jones as directors at the annual election in November. The former will serve for a three-year term, and the latter will fill out the term of L. E. Daigler, resigned. The election of the Snow Creek District resulted in the choice of Edward Dean to succeed E. Pringle.

R. H. Tucker, former county agent of the agricultural extension service in Montrose County, Colorado, assumed a corresponding position in Delta County in December. He is succeeded in Montrose County by Henry A. Ireland, who has been agriculturist on the Uncompahgre reclamation project. The transfer of Mr. Tucker to Delta County gives that section extension service after a lapse of several years.

Forbes Fosberry and J. C. Calhoun were elected directors of the Grants Pass, Oregon, Irrigation District in November. William Hanley was chosen director of the Harney Valley district. E. F. Barnard was named to succeed himself as director of the Ochoco district. The Jefferson County unit of the Deschutes project named John Henderson as a director. George Cyrus was returned to office in the Squaw Creek District.

A party of representatives of California bond houses, including Thomas W. Banks, of Banks, Huntley & Co., John H. Dinkins, of M. H. Lewis & Co., and E. V. Carter, of Carstens & Earles, Inc., recently visited the Exchequer Dam and other developments on the Merced (California) Irrigation District. With them was H. C. Dinkins, Mexico City railroad man. The party was conducted over the district by Engineers R. V. Meikle and Ross White, and by Alger Fast, financial comptroller of the district.

Thirty-three prominent business men of Los Angeles recently staged a friendly invasion of Arizona for the purpose of getting acquainted with the state's resources and problems, and of promoting plans for Arizona-California colonization and co-operation. The party included R. W. Pridham, president of the Los Angeles Chamber of Commerce, William Lacy, chairman of the Arizona relations committee of that organization, W. T. Bishop, former president, D. W. McGarry, vice-president, and seven directors.

Sixteen irrigation districts in Yakima County, Washington, will hold their annual elections early in December. Districts included, and the retiring officers are: Wenas, R. C. Babbitt, president, J. B. Fink and Guy Longmire, trustees; Selah-Moxee, Ovid Brulotte, president; J. D. McAuley and William Meiras, trustees; Yakima, L. O. Janeck, president, Merritt Longmire and Charles Cowan, trustees; Terrace Heights, Ed Remy, Jr., president; Charles Westaby and J. Reutter, trustees.

Yakima-Tieton, H. M. Gilbert, president; Dan Williams and W. I. Huxtable, trustees; Sunnyside Valley, Frank Fyfe, president; E. C. Houston and R. J. Core, trustees.

Granger, J. E. O'Brien, president; O. J. Chapman and George Eaton, trustees; Yakima-Reservation, F. A. Wiggins, president; Harry Jones, Otto Halverson, Lloyd Purdin and E. J. Flannigan, trustees.

Appraisers of Vale District Classify Lands in Report

Appraisers appointed to investigate and evaluate the lands of the Vale, Oregon, Irrigation District, named under the Fact Finders Act, have completed their work and filed their report. B. E. Hayden, representing the government, J. D. Fairman, for the district, and Ross Madden, selected by the two first named as a third member of the board, were the appraisers.

They found within the boundaries of the district a total of 40,342 acres, according to the report. Of this they excluded a total of 10,656 acres, including 9,575 acres of good fertility but too rough for practical irrigation and 1,082 acres which are alkaline.

Of the remainder of the area the board found 27,215 acres of raw land, and 2,851 now being farmed.

The report does not place values on the farmed land, but classifies the raw land as follows:

Special class: "Lands of such high grade and so smooth, that we could not in justice ask class A lands to measure up to their standards, and therefore were classed by themselves," 1,510 acres, valued at $15 per acre.

Class A. Lands of high fertility, smooth and free from breaks and washes, 10,405 acres, value $13 per acre.

Class B. Lands of high fertility, but rougher or more sloping than class A, 8,285 acres, value $9 per acre.

Class C. Lands of good fertility, but rough; or level lands of lower fertility; 7,014 acres, value $5 per acre.

Class D, rough. Lands of good fertility, but too steep for practical irrigation, railroad rights of way, beds of streams, etc. 9,575 acres. No value determined.

New Book Treats Drainage

"Drainage and Flood Control Engineering" is a new work on an important branch of hydraulic science which has recently come from the presses. The author is George W. Pickels, Associate Professor of Drainage Engineering at the University of Illinois. The book presents the fundamentals of drainage and flood control engineering as applied to the improvement of small areas of cultivable land and to the reclamation of large areas of wet and overflow lands. It emphasizes the new importance of hydrology, hydraulics and soil physics in the design of drainage systems and treats the essentials of these subjects from the viewpoint of the drainage and flood-control engineer. Copies may be ordered through MODERN IRRIGATION, at $4.00 postage prepaid.

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RECLAMATION

FACTS FOR THE PROSPECTIVE PROJECT SETTLER

RESULTS of a recent investigation conducted by the U. S. Bureau of Reclamation, to determine facts connected with the worth of land, financing facilities, and capital requirements on each of the federal reclamation projects, are presented in the November issue of the NEW RECLAMATION ERA, official publication of the Bureau. The table on this page is a part of the data given by that publication, and the complete report as it appeared in the NEW RECLAMATION ERA follows:

The Reclamation Bureau recently called for information concerning the price of improved and unimproved land on the projects, the best size of farms, the cost to improve and equip the farm, and the amount of capital needed by an experienced settler, exclusive of the purchase price of the farm, in order to succeed on an undeveloped farm. The replies, as far as received, are summarized in the accompanying table.

SETTLEMENT AND FINANCIAL DATA FOR FEDERAL RECLAMATION PROJECTS, AS COLLECTED BY THE RECLAMATION BUREAU

Project	Price of private land per acre		Best size of farm (Acres)	Cost to improve and equip farm	Amount of capital needed by experienced settlers, not including purchase price of farm
	Improved	Unimproved			
Yuma	$150-$ 250	$ 50-$150	40	$3,000-$5,000	
Orland	250- 750	125- 150	20	5,000-10,000	$5,000
Grand Valley	90 150	20- 50	40-60	2,000	3,500
Uncompahgre	50- 250	20- 100	40-60	2,100- 4,600	2,000- 5,000
King Hill	35- [1]150	[1]15	40	5,000	
Minidoka	75- [1]150	50- 75	40	4,000- 5,000	3,000
Huntley	75- 150	10- 50	60-80	6,000-10,000	3,000- 5,000
Milk River	30- 75	15- 40	80	3,000- 4,000	3,000- 5,000
Lower Yellowstone	40- 125	20- 50	80	3,000	2,500
North Platte	70- 200	40- 100	80	6,500	5,000
Newlands	150	20	40	4,000	4,000
Carlsbad	75- 250		60-80	3,500- 5,200	4,000
Rio Grande	150 250	75- 150	20-60	2,000- 5,000	2,000- 5,000
Umatilla	150- 200	30- 50	40	8,000	5,000
Klamath	125	20	40-100	4,000- 7,000	1,500
Belle Fourche	40- 125	20- 50	80	4,000- 6,000	2,500
Strawberry Valley	100- 200	75- 100	40	2,000- 3,000	2,000- 3,000
Okanogan	500- 1,000	100- 150	5-10	3,500- 7,000	2,500- 5,000
Yakima	800 2,000	40- 75	20-80		5,000- 7,000
Riverton		15- 25	80		2,000- 5,000
Shoshone			60-80	4,000	2,000- 4,000

[1]And up.

An additional question covered the sources from which settlers can borrow money to supplement their capital to develop farms, the length of payment period, and interest rates. Information on this important point was furnished by the projects as follows:

Yuma project, Arizona-California.—Local banks loan money on crop mortgages or under certain conditions as second mortgages upon the farm at rates of interest running from 8 to 10 per cent. Generally these loans are short time loans upon crop mortgages. The loan is made in the spring or summer and is paid out of the first returns of the crop.

Orland project, California.—Settlers can borrow money from the Federal Land Bank of Berkeley, Calif., the Pacific Coast Joint Stock Land Bank of San Francisco, and private banks, all of which make loans on practically the same terms offered by the Federal land bank, whose terms are 5½ per cent on a loan extending over 31 years.

Grand Valley project, Colorado.—Very few agencies are furnishing money on farms for farm equipment. Most of the land sold for the last few years has been with a small down payment and three or five years for the balance. The deferred payments usually bear interest at 8 per cent, with an occasional loan at 7 per cent. Money is available for short chattel loans from local banks, with a usual period of six months and at the rate of 9 or 10 per cent. The best merchant paper well secured carries an 8 per cent rate.

Uncompahgre project, Colorado.—Available sources of loans are banks, loan companies, and individuals. The farm-loan bank is not at present operating in the valley under the project. Loans are usually made for a period of three years, occasionally for five years, the rates averaging 8 per cent for real-estate mortgages and 10 per cent for chattel mortgages.

King Hill project, Idaho.—At the present time money can not be obtained on the project farms; and farms in the making stand less chance of obtaining credit. Short-time money is loaned to some extent on crops and chattels, and the usual rate is 10 per cent, although lower in some instances.

Minidoka project, Idaho. — Long-term loans can usually be obtained from mortgage companies and sometimes from the land banks. Short-term loans on crop mortgages can be obtained from local banks. The prevailing terms and rates for real-estate loans are five years' time and 8 per cent interest. Local banks charge 10 per cent interest on chattel and crop loans, the usual term being three to six months. Renewals can usually be obtained where security is good.

Huntley project, Montana.—It is very difficult to borrow money at this time. About the only available source is the Federal land bank. The repayment period covers 33 or 34 years, with interest at about 5½ per cent.

Milk River project, Montana.—The right sort can borrow locally, but must show that they are workers and know how to farm under irrigation. Payment period, 10 years; interest 6 per cent.

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Lower Yellowstone project, Montana-North Dakota.—The Federal land bank does not favor loans on this Government project and the local banks can handle only small amounts of short-time paper. The interest rate is 10 per cent on this class of loans.

North Platte project, Nebraska-Wyoming.—Money to supplement capital can be borrowed at local banks and from loan companies. Such loans usually run from one to three years and bear interest at 8 to 10 per cent.

Newlands project, Nevada.—"It is impossible for a settler to borrow money on his homestead until he has secured a patent from the Government."

Carlsbad project, New Mexico.—The best source is the Federal land bank, which loans up to 50 per cent of the estimated value of the farm. The length of payment period is 34 years, and the interest per annum, including payment on principal each year, amounts to 6 per cent.

Rio Grande project, New Mexico-Texas.—Federal farm loan banks operate in both districts of the project, and loans are made from such source in reasonable amounts.

Umatilla project, Oregon.—There is no available source at present where money can be borrowed to develop a farm. Money is available only for improved places. For example, if a settler were to level 40 acres of land and build his flumes or ditches, he could not borrow money on his farm. If, however, he had enough capital to get a good stand of alfalfa on 20 acres, he might get a $1,200 loan on a first mortgage. Private capital is out of the market for loans on irrigated lands.

Klamath project, Oregon-California.—Local banks help finance those able to show material and moral assets. Ordinarily notes run 90 days to 6 months, sometimes 9 months. The interest rate is 8 per cent.

Belle Fourche project, South Dakota.—Local banks have restricted loans to such an extent that only the best farmers with Class A security can obtain short-time loans. The Federal land bank and larger loan companies are not operating on the project, and the State rural credit has suspended activities.

Strawberry Valley project, Utah.—Farmers are usually financed through local banks. Seasonal loans for six months are obtained at 8 per cent interest; mortgage loans for 5 to 10 years bear 7 per cent; and the Federal Land Bank of Berkeley, Calif., makes long-time loans over a period of 34 years on the amortization plan at about 5½ per cent.

Okanogan project, Washington.—Local banks and mortgage companies are the sources for loans to supplement settlers' capital. At present real estate loans are difficult to secure. Mortgages run from 3 to 10 years, with the average interest rate about 8 per cent. Short-time loans are made at 9 and 10 per cent.

Yakima project, Washington.—Money may be borrowed from private loan companies on unimproved land of good quality; and the Federal land bank and mortgage loan companies loan reasonable amounts on improved land at varying rates from 5 to 8 per cent.

Riverton project, Wyoming.—Settlers of good character on unimproved land whose farm equipment is unencumbered can get money for seed and similar purposes from local banks on chattel mortgages for a term of six to nine months at 8 to 10 per cent interest.

Shoshone project, Wyoming.—At the present time it is doubtful if a new settler could borrow money to supplement his capital. The local banks have loaned to the limit. The State of Wyoming has appropriated $2,000,000 to be loaned to farmers of the State under a 30-year 5 per cent amortization plan of payment, but as yet none of this money has been placed on the project.

Reclamation Bureau Makes Annual Report to Chief

Financial Policies are Most Difficult Problems, says Mead; Requests for Deferments are Considered

The annual report of the Commission of Reclamation, submitted early in December to Hubert Work, Secretary of the Interior, by Commissioner Elwood Mead, declares that the fiscal policies of his bureau during 1925 constituted the most pressing and difficult problems encountered.

Thousands of requests for deferment of payments due the government were received from water users, were entitled to sympathetic consideration and received it. The deferments amounted in the aggregate to a large sum. Commissioner Mead states, however, that there were other requests to approve which would abuse the Government's generosity. Requests from irrigators amply able to pay, from non-resident landowners whose farms are cultivated by tenants, and from those who openly oppose all payments to the Government, had to be refused.

During the last five years there has been a progressive decrease in payments made on certain projects. Delinquencies for that period amount to the staggering total of $8,500,000.

Commissioner Mead points out that the theory of Federal reclamation is that it shall be self-supporting. The money

For Detailed Listings, Branch Offices, Etc., See the Buyers' Guide to Leading Supply Sources—Pages 55-56

spent to build irrigation works is to be returned to the Government. Water users are to pay all the costs of operation. This theory is not only sound, but it is the only one under which the policy of Federal reclamation can be justified. The Bureau of Reclamation is working to make this theory a fact.

Seven projects are characterized as a source of confidence and satisfaction, having paid more than 85 per cent of charges and assessments. Seventeen have paid more than half. The payments of the remainder are so inadequate and the morale of settlers on some is so low that measures to check this downward course toward insolvency are held to be imperative.

Insistence on payments, instead of discouraging the water users, has increased their confidence and has had a great influence in maintaining the morale of the administration of the bureau, the report declares.

Williston Sale Authorized by Interior Secretary

Sale of the Williston Reclamation project, located at Williston, North Dakota, for the sum of $151,388 has been authorized by the Secretary of the Interior. The plant is to be sold to the United Power Company of Crosby, North Dakota. This company made the highest of five bids publicly opened at Williston on November 2. According to the terms of the sale as approved by the Secretary, the $151,388 will be paid in 20 annual installments of 5 per cent each with interest on deferred installments at the rate of 6 per cent.

The company also agreed to pay at the rate of 20 cents for each ton of coal mined from the Government coal mine owned and operated in connection with the power plant of the project. The next highest bidder was Daniel R. Croswell, Brainerd, Minnesota, whose tender was $80,000. A group of six water users of the project offered to pay $150 per year for a period of ten years.

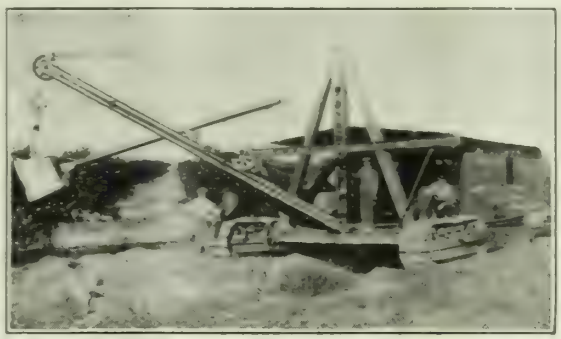
Congress authorized the appraisal and sale of the Williston project last Marrch as this was one of the projects which has been operating at a loss for many years. The original construction cost of the project was approximately $470,000, of which none has been repaid the Government.

The Interior Department also announced that the project headquarters in Williston and a small tract of land near Buford, North Dakota, would be offered for sale. The property was ordered appraised and later will be sold through competitive bidding.

For Cleanout -- Maintenance -- New Ditches

There's a Bay City for Every Job

BAY CITY Land Dredges span the ditch, can dig any desired slope, and dump waste on both banks. BAY CITIES leave clean, wide berms, and can work up or down streams. One trip over the ditch is enough. The Shovel Type Dipper handles hard material in which other types of buckets cannot make a good showing.



At left—One yard BAY CITY Dredge digging and cleaning ditches in Florida Citrus Groves.

BAY CITY Land Dipper Dredges are built to fit the job. Walking, Crawler, Track or Floating mounting. Easily dismantled, transported and assembled. Capacities ½ to 1½ cubic yards. Oil engine or electric operation.

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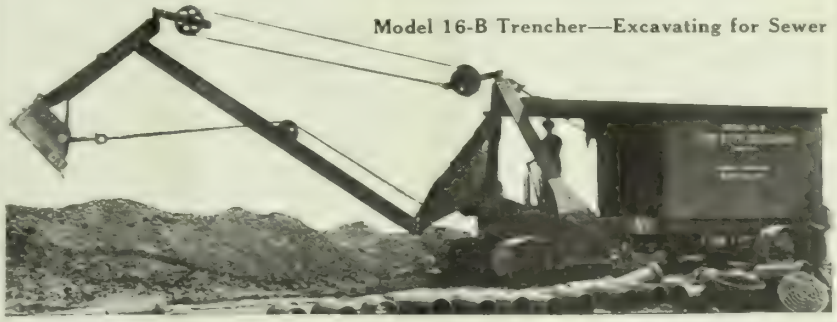
The BAY CITY 16-B convertible Excavator will handle a wide range of work. Operates Dragline, Trench Shovel, Clamshell or Skimmer. All steel. Shipped assembled. Digs any width or depth up to 20 feet.

Model 16-B Trencher—Excavating for Sewer



or—Model 4 Excavator

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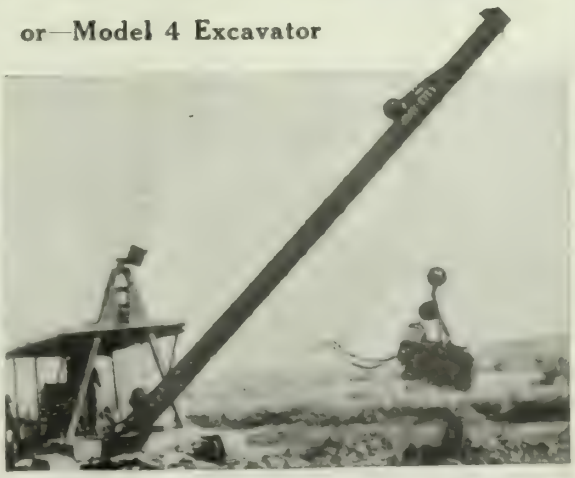

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IRRIGATION FINANCE

A FARM LOAN BANK PRESIDENT LOOKS AT IRRIGATION

By GEORGE C. JEWETT

President, Federal Land Bank, Spokane, Washington

THE Federal Farm Loan System is designed for the development and betterment of agriculture, and the Federal Land Bank of Spokane is anxious to serve in this respect. We appreciate fully the great benefits that reclamation has brought, and we further appreciate that some of the very best loans that are available to any mortgage company are those which have, as their underlying security, irrigated lands.

In our judgment there is only one matter to be considered in contemplating such loans, but that is a big matter and one of great importance. It is as to the soundness of an irrigation project, both physically and economically. When we say physically, we refer to its physical features such as the adequacy of its water supply, the permanence of its dams, laterals, canals, etc., and the character and topography of the land to be irrigated and the possibility or probability of dangers from seepage, necessitating drainage.

These, as every irrigationist knows, are fundamental factors, and in determining the value of irrigated lands must be carefully analyzed and taken into consideration.

THE ECONOMIC factors are of like importance, and refer mainly to the operation and maintenance charges, the bonded indebtedness, the character of the production and the income derived therefrom. There is a fixed relationship between each of these factors, and it must be in proper proportions. Operation and maintenance is always a matter of relative character as measured against the income that the land can be expected to provide. In some sections of our territory, an overhead charge of 50 cents per acre for a season might be considered excessive inasmuch as the land, on account of soil and climatic conditions, might be of a low income character, and that small charge might be out of proportion, while, on the other hand, in some parts of our district an overhead charge of from $8.00 to $10.00 per acre might not be treated as excessive, owing to the productivity of the land and the high money value of the crops that the land is best suited to produce.

These are matters familiar to everyone interested in irrigation, but we must confess that sometimes they appear to be overlooked. It is not a criticism of reclamation or an indication that we are not believers in reclamation when we say and point out that there are many irrigation districts in which the Federal Land Bank operates that should never have been formed. There are many in which the physical factors are unsound, and can but mean disaster in the final analysis. There are many more in which the economic factors may be said to be impossible.

MR. JEWETT, as president of the Federal Land Bank in Spokane, Washington, is naturally most interested in the irrigation and reclamation problems of the northwest, and throughout the accompanying article refers to "our district", meaning the territory served by the institution which he heads. Many of the points with which he deals, however, in addition to having a special application to northwestern problems, will apply with equal force to other irrigated areas; and the suggestions which he makes concerning the organization of the marketing end of the industry, and the credit facilities provided for irrigation farmers through the Federal Land Banks and Federal Intermediate Credit Banks, touch vital questions which are encountered in irrigation wherever it is practiced.—Editor.

TO FORM a district or a project and offer it to the farming public where the operation and maintenance is out of proportion to the possible income, and where the bonded indebtedness for reclamation and construction charges is in excess of a fair valuation for the land, is but injuring sound irrigation, and placing a damper on the development of future projects. The Land Bank has many of this character of districts or projects to contend with, and, of course, as a sound money loaning institution, it is compelled to withhold its services from such territories.

Another factor which we must take into calculation, and which is a very important one in making loans in any irrigated territory, is the relationship that cultivated productive acres bear to the total acreage under the project. The cultivated productive acres are the only ones producing an income of a substantial character, and therefore must bear the burdens incident to the operation and maintenance of the district, bearing not only their own burden on an acreage basis, but bearing that portion that would be borne by the uncultivated acres if they were in a productive condition. This factor alone has compelled us to withhold our service from a number of districts where the area of non-producing land was quite extensive.

We are sure a number of districts have met with disaster for this very reason alone, as the burden on the cultivated acres, taken by themselves, was so great that the owners and operators of same were unable to succeed, and therefore permitted the charges to go uncared for, and eventually were compelled to abandon the lands.

AS I TRAVEL over irrigated areas in our district, I am continuously reminded of the fact that soil and climatic conditions are such that a high production is assured. It is very seldom that any district fails to produce an abundance of crops for which the district is best adapted, but I regret to say that that does not necessarily mean a proper income for the district. I refer specifically to the matter of markets. We find, in this territory, an abundance of crops, which in many instances are moving at an unsatisfactory price, and other crops that are not finding a market at all. There is no matter so important to American farming and those who are depending upon that industry for their suc-

cess, as the one of proper markets. Experience has taught us that we can increase our values and better justify our markets in territories where the farmers are organized with sound cooperative marketing institutions, and therefore have a better assurance that their production will result in a proper money income.

There is only one way out, insofar as this problem is concerned, and that way must be taken by the producers themselves. It is to do, in short, as other territories have done, the best example being found in California, and organize their own cooperative marketing institutions. It is often said that farmers' cooperative marketing institutions cannot succeed, and it is pointed out that many have failed; but that is true of any enterprise, and while many have failed, many are succeeding and have caused conditions in the territory they serve to change from highly unsatisfactory to highly satisfactory. Those interested in the development of reclamation can well afford to also devote their attention to the development of better marketing facilities, and better markets.

The Federal Farm Loan System is now supplemented through the Federal Intermediate Credit Banks, which are designed for financial service to farmers covering an intermediate period; that is, a period longer than the average commercial bank desires to loan for, and a period not so long as the farm mortgage loan that the Federal Land Bank handles. The Federal Intermediate Credit Bank of Spokane is rendering aid to the dairy industry, livestock industry, cooperative fruit associations, and cooperative wool associations. They have a loan that is fitted to the needs of these organizations, and they are anxious to extend their service in every legitimate way that may be provided.

Most certainly with the Federal Land Banks and the Federal Intermediate Credit Banks, the farmer has at his call the very best in the way of service that is available to any industry.

Oregon Pays Bond Interest

A check in the amount of $44,561.95 was sent by the state treasurer of Oregon to the National City Bank of New York on November 30 to meet interest on Oregon irrigation district bonds which are guaranteed by the state.

Oregon Drainage Body Meets

The Oregon State Drainage Association will meet at Salem December 15. One of the matters to be considered by the organization will be a proposal to consolidate with the Oregon Reclamation Congress. A resolution will be introduced at the meeting urging the federal government to return to the state of Oregon for reclamation purposes, at least, a large part of the $6,000,000 derived from the sale of public lands in that state.

Guarantee Eagle Point Bonds

The Eagle Point (Oregon) irrigation district has been granted an extension of interest guarantee of six months by the Oregon irrigation and drainage securities commission, during which the state will continue to guarantee the interest on the district's outstanding bonds, amounting to $400,000. It was announced that if the district would demonstrate that it had a practicable settlement plan, looking to the colonization of the project, the interest guarantee would probably be further extended. The Eagle Point district is located in Jackson County, and includes approximately 5,000 acres of land.

Sells $600,000 Issue

The Camas Mutual Irrigation District (Idaho) has sold a $600,000 bond issue to New York financiers. The funds will be used in the construction of a dam, canals and laterals for the irrigation of a tract of 11,000 acres in Clark County. Terms of the sale contract as reported in the press stipulate a first payment of $120,000 in April, when construction work will be commenced, followed by payments of like sums at intervals of two months until the whole amount is paid.

Water Bonds Bring Premium

An issue of $500,000 4½ per cent San Dieguito water bonds were sold in November by the city of San Diego to the Detroit Company and the Old Colony Trust Company, whose joint bid of par, plus accrued interest, plus a premium of $1363, was the highest of several tenders submitted. The half-million dollars will be used by the city as a payment on the option to purchase the San Dieguito water system.

La Mesa Bonds Bring 97.76

A million and a half dollars in bonds of the $2,500,000 issue of the La Mesa, Lemon Grove and Spring Valley irrigation district, California, was sold in November to a syndicate including Pierce, Fair & Co., Hunter, Dulin & Co., First Securities Co., M. H. Lewis & Co., California Co., and Banks, Huntley Co., all of Los Angeles, at 97.76. Three other bids from irrigation bond houses were submitted, ranging from 95 to 96.75.

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Ball Bearing Centrifugal Pumps direct driven by Fairbanks-Morse Ball Bearing Motors—the ideal pumping unit.

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More than just a stopping place; a central point from which you enjoy most thoroughly all San Francisco's attractions—the beautiful Plaza overlooking Union Square.

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How About Credit?

(*Continued from Page 18*)

trict can not be successful. On the other hand, the officials of the district should take a personal interest in the problems of the landowner and the individual farmer. There is much that the officials can do to assist the farmer to become successful in his farming operations. Water users should realize that it is impossible to maintain a successful project unless taxes are paid promptly. Many district boards will not deliver water to water users until their taxes are paid.

Prompt payment of irrigation taxes will mean success to any project if properly managed, while on the other hand if taxes are allowed to become two or three years in arrears, the accumulated taxes together with ten to fifteen per cent interest will make such a burden that the average landowner can not succeed. The tax sale does not cure the situation by any means. While the district receives the money when a tax sale is taken, the officers of the district know if the tax sale is for a considerable amount that in many instances a good farmer is eventually forced to leave the project. This same farmer, if required to pay his irrigation taxes each year before receiving water, would in most instances manage to do so and would finally succeed.

Trenching and Backfilling

(*Continued from Page 19*)

special 2½-ton capacity truck. This 800-gallon-per-minute pump is unique, in that it requires no suction hose, pipe or priming, it being only necessary to connect up the discharge hose, push the button and the pump does the rest. At the same time it generates enough current for a large number of ninety-candle-power lamps. This piece of equipment was designed and assembled in the Department machine shop.

All repair work and overhauling is done in the Department machine shop and there is not one unit of this trenching and pipe laying equipment that is not doing its bit toward furnishing the people of Los Angeles with the most necessary of all commodities—domestic water.

Avocado Growers Meet

Avocado growers of Orange County, California, met on November 28 at La Habra for their fourth annual field day. Experts in irrigation and other phases of the culture of avocadoes discussed problems affecting the growers. J. B. Brown, irrigation specialist of the University of California College of Agriculture, spoke on "Contouring and Terracing for Hillside Irrigation."

Irrigation Men Prominent in Road Show Attendance

Heavy Duty Equipment Displayed at All-Western Exhibit Interests Hydraulic "Prospects"

Although the All-Western Road Show, held in San Francisco November 9th to 14th, was primarily designed to interest the street and highway builders of the eleven western States, manufacturers of much of the equipment found a very interested portion of the daily attendance composed of irrigation and reclamation engineers, and officials of irrigation districts.

A number of these companies were able to report sales in a field not classed as road building, but nevertheless greatly interested in the same equipment that the purely road building specialist uses.

Several pieces of heavy equipment, notably draglines, cranes, shovels and scrapers were sold from under the big tents, to be put to work on irrigation tasks. Prospects for the larger types of concrete mixers to be used in hydro-electric projects were carefully listed by this group of manufacturers.

The show itself, the largest exhibition of excavating and ground working machinery ever held, assumed a total of almost three million dollars worth of equipment, housed under the five acres of spread canvas on the San Francisco Marina. Back of the project was the Western Construction Equipment Distributors Association, with P. H. Curtis, Tracy Harron, Charles A. Spears and Edward R. Bacon as the active leaders of the entire project.

Problems of Power and Water

(*Continued from Page 17*)

When the eventual development has been reached, there will be several dams and power plants on the river; and a comprehensive plan of operation of the plants on one system, or on interconnected systems, will make it possible to suit both power and irrigation requirements without waste, by proper regulation of the flow between the successive reservoirs. The reservoir at the lower end will be regulated to suit irrigation and flood control demands below it; and those above it will regulate mainly in the interest of power.

On This Month's Cover

The tint picture on this month's cover shows work in progress on the Exchequer Dam, on the Merced River, California—one of the great projects now going on in the west. Completion of the dam is expected early in February, 1926.

MODERN Irrigation

Have You a Delegate at This Meeting?

THE COMPETITIVE business world of today moves forward on two wheels. One of these is salesmanship proper and the other—*advertising*. Whether you realize it or not, business amounting to billions is now transacted annually through the advertising pages of magazines and industrial publications. It is *here* that the preliminary skirmish of competition takes place and many a silent victory is won, or nearly won, before the salesman calls.

The advertising pages of MODERN IRRIGATION are a market-place. Here, once each month, is held a sales convention on paper. Here representatives of the leading equipment manufacturers speak their messages to the great market that buys your products.

These "silent salesmen" are an indispensable part of the general campaign; as necessary in their way as is the personal representative who stands between you and your customers, and your prospective customers. Do not, like the fabled ostrich, hide your head in the sand and imagine otherwise. You may, by cultivating such an illusion, go on saving the cost of a monthly advertisement; but if that is your policy you are slowly and certainly losing prestige, business and good will—of a far greater value to you—and making it easy for the more astute competitor, who does not believe in such limitation of armaments, to penetrate your market, overcome advantages which you hold in fancied security, and eventually outflank you on this important sector.

At this moment, the pages of MODERN IRRIGATION are being examined, and examined carefully, by men whose yearly purchases in your line aggregate large sums of money. Long-pull advertising will help you to secure a larger percentage of this annual turn-over. The men who buy are reading and studying these advertisements—never doubt it. Consciously, or unconsciously, they are forming their opinions and narrowing down their ultimate choice of equipment. Many *actual decisions* are made months in advance of the order for the goods. None but the most backward companies in business today are not fully alive to this, while those of seasoned advertising experience are now, as never before, bringing up their advertising artillery for the big year's business ahead.

There will be no disarmament in the business world the coming year—no unpreparedness in the organizations of progressive business concerns. Competition will be keener than ever before. The personal skirmishes and "bouts" of your salesmen and distributors in the field will have their counterpart in the drive for business and prestige through the advertising pages. Laggards and sluggards will drop out, and fall by the wayside. Live, up-and-going companies will go forward on "both wheels."

Think the matter over. The monthly meeting on these pages will go right on, month after month, and the silent but efficient emissaries of the leading companies in your line will be present. Your own advertisement gives you representation according to your merits. Why not decide upon a campaign now, and let us talk the subject over with you?

We'll be glad to introduce your "Silent Delegate" at the next monthly meeting.

For Detailed Listings, Branch Offices, Etc., See the Buyers' Guide to Leading Supply Sources—Pages 55-56

OVERHEAD IRRIGATION

A PACKING-HOUSE MANAGER COMMENDS 'OVERHEAD'

By HUGH CRANE

WE WERE sitting in the manager's office at the packing house of the Sierra Madre-Lamanda Park Citrus Association—Frank Weber, the manager of the packing house, and the writer, who had gone to him for some information on how a packing house manager regards overhead equipment for citrus growers.

A member of the association entered to discuss some matter of fumigation or spraying with the manager. Mr. Weber, hoping to get a new slant on the problem for me, asked him: "Jim, do you have overhead irrigation on your place?"

The reply from the grower seemed characteristic of the attitude shared by many of the citrus growers in southern California, especially in the territory served by this particular citrus association.

He answered: "Not yet."

"Not yet" is the feeling of a great many of those who are interested in overhead equipment. "Not yet" implies "I'm sure going to have it when I can." It also carries just a hint, perhaps, of: "I'll put it in as soon as some of the questions connected with it are answered to my entire satisfaction—questions which are still open because of the youth of the overhead idea." But it augurs well for the future of overhead.

ABOUT A DOZEN members of the Sierra Madre-Lamanda Park Assocation have their ranches equipped with overhead sprinklers The association includes about 1,600 acres in its membership and approximately one-tenth of this is overhead-equipped. Most of this acreage is in small ranches, usually about ten acres. Two twenty-acre orchards are overhead ranches.

While ten per cent of the association's acreage is not a large proportion, it is, at least, a fairly representative share, and it is for that reason that the writer sought Mr. Weber for his ideas on the merits of the overhead system.

I put the situation before him like this: "Mr. Weber, I am interested in the subject of overhead irrigation. I have heard from various sources that it is a wonderful thing. Men who are enthusiastic about it have told me that it has numerous advantages, for many purposes. They have said that it improves the quality of the fruit, that it increases the proportion of fancy grades, that it reduces evaporation, that it protects against damage from wind and heat, that it reduces frost danger, etc., etc. On the other hand there are the men who admit that it has certain of these advantages, but who are extremely skeptical about the others. What I should like to get is something definite, free from mere matter of opinion, estimates, guesses, individual judgment—something based on definite records that speak for themselves. What can you give me?"

MR. WEBER replied: "I'm sorry that I can't give you very much. While it is true that we have a comparatively large acreage of overhead in this association, and that this method of irrigation is apparently becoming more popular with our members, and I have some very definite ideas on it based on my observation of its results, I can't give you data of the kind you want. And this is the reason: In every case our growers who have the sprinklers have their entire holdings so equipped. In order to make a comparison between the fruit grown under overhead systems and that irrigated by the old furrow system, it would be necessary to make records of the performance of two parts of the same ranch, where the irigation was substantially the only difference in cultural methods. This has not been possible in this association because where a grower has installed the overhead equipment he has usually had only a small acreage and has put his entire ranch under the sprinklers. Comparisons between the yields of one grower practicing furrow irrigation and another who has the overhead equipment would be valueless, and therefore they have not been made.

"Neither overhead irrigation nor any other *one* thing will give good fruit and success in citrus growing if the general cultural methods are not right, and there are too many variable factors as between different soils, different stocks, different growers and their different methods of pruning, fumigating, spraying, cultivating, and other elements of culture, to make valid conclusions possible based on comparisons between them.

"I have formed some very definite conclusions, however, based on my observation of overhead irrigation in this association. It was first called forcibly to my attention several years ago when I noticed that a picking of fruit from a rancher in the La Canyada district was remarkably free from 'tree-ripe.' I inquired into this and found that he had overhead equipment.

"I watched his subsequent pickings, and found that they were consistently free from tree-ripe lemons. He ascribed this to the influence of overhead, and as I have found that it is generally true on all our overhead acreage, I have no doubt that overhead sprinkling does eliminate the objectionable tree-ripe fruit, and brings the lemons to the packing house showing a very desirable uniformity of color.

"I believe also that it improves the quality of fruit in other ways, giving a smoother, firmer texture, and giving the grower a measure of control over unforeseen difficulties that sometimes occur to reduce the proportion of high grade fruit in his crop.

"I am thoroughly convinced, also, of this—that it gives better results with less water on light, foothill soils, which are characteristic of much of the acreage in this association, than can be obtained under furrow irrigation.

"I am like some of the critics of whom you have spoken in questioning its value as to some of the claims that are made for it. I think that there is little doubt that its value for frost protection is negligible. It may be of some slight assistance in raising the temperature under conditions of a very light frost, but such a cold snap would not amount to anything, anyway. I also question its efficacy in the control of pests. But as for its usefulness for the growers in this district whose soils are of the light, foothill type, why, they are finding it a great success."

We make complete installation if desired

This new Sprinkler will practically last a lifetime. We guarantee it unconditionally for five years.

Oil or grease cup in which adjustable hardened cone thrust bearing operates.

A *New Type* Campbell

Overhead Irrigation Sprinkler

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AND

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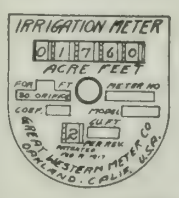

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Oakland California

Finds Overhead Irrigation Reduces Wind Damage

W. W. Read, Orange County (Cal.) rancher, who owns a citrus orchard near Olive, is a strong believer in the overhead method of sprinkling. One of the big advantages of this method of irrigation, according to Mr. Read, is the protection which it affords against hot, dry winds which peridically afflict fruit growers in many parts of the southwest.

Mr. Read has been experimenting with his overhead system as a possible preventive of scorching of trees by electricity carried in the air when desert winds are blowing. His experiments so far have not been entirely successful, but results have been such that he has been convinced of the possibility of this method of irrigation being effective in preventing wind damage to trees.

He installed the system throughout his grove last spring, following an experiment with one tree the previous year. At the time of a heavy wind, on Oct. 10, 1924, Read singled out a tree in his orchard and kept a spray of water running on it during the storm. The tree was not damaged but others in the orchard were.

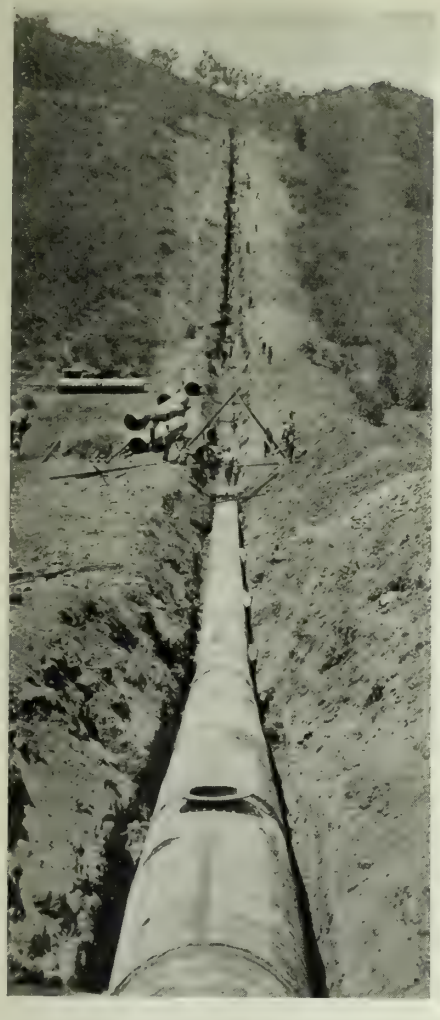
Desert storms this year have damaged his trees, Read admits, but he attributes this to his failure to get sprinklers in operation in time. He failed to start his sprinklers until the wind had been blowing two days. He will continue the experiment, and before making final decision as to efficiency of the plant in preventing scorching, will await the next storm, when he will start the sprinklers at the first indication of wind and keep them in operation throughout the period of the storm.

Regardless of what benefit it may be as a preventive of damage by wind, the sprinkler system is worth all it costs and more, declares Mr. Read. He says it offers more even distribution of water and at the same time effects a 25 per cent saving in water. The system cost this grower $300 an acre for installation and it costs him 1 cent an inch per hour for operating, the water being pumped under pressure to the system from an irrigating ditch near by.

Mr. Read is emphatic in his declaration that there is no justification for the claim that overhead sprinkling will eliminate red spiders or purple scale. He does maintain, however, that the pests can be kept in check.

Asserting that new growth on his trees this year is four times greater than that of trees in adjoining orchards where the usual irrigation methods are employed, Read attributed this fact to the better aeration of the ground resulting from sprinkling.

For Detailed Listings, Branch Offices, Etc., See the Buyers' Guide to Leading Supply Sources—Pages 55-56



It's Not Concrete

The illustration which appears above was used in the November issue of MODERN IRRIGATION in connection with the article by Kenneth Q. Volk, chief engineer of the Vista Irrigation District, describing construction activities of that district. Under it appeared the erroneous caption: "Laying a concrete siphon over a precipitous incline."

The construction described by Mr. Volk included extensive use of both concrete and steel for the distribution of water, and illustrations were submitted showing typical examples of both. In some way the captions for the pictures were transposed, with the result that the installation shown above, which is obviously steel, was labelled concrete, and the picture of the installation of a concrete siphon, appearing on the cover, was referred to as steel.

The steel siphons installed on the Vista Irrigation system were supplied by the Western Pipe & Steel Company of California, and special apologies are due to that company for the error.—EDITOR.

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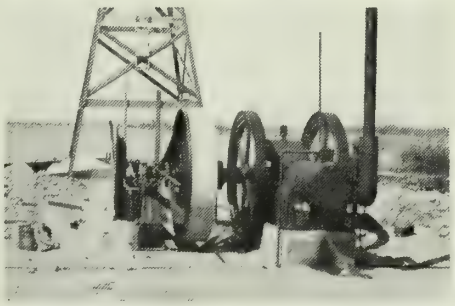

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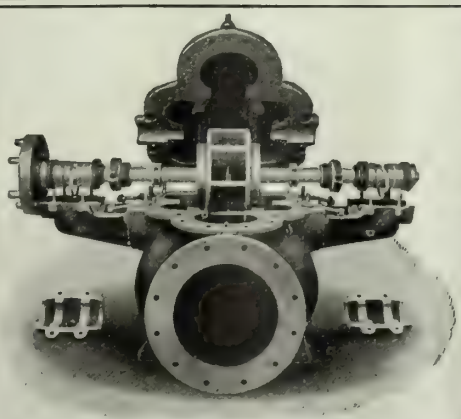

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SURVEY *of* IRRIGATION DEVELOPMENT

As Shown by Official Records of the Month -- Local, State, and Governmental

OFFICIAL RECORDS FORESHADOW BIG DEVELOPMENTS

AMONG the more important permits to appropriate water issued by the Department of Public Works, Division of Water Rights of California, during the month of October, 1925, were the following:

Permit No. 2260, Application No. 4410 (San Diego County). Issued to Walsh and Betsworth, Valley Center, Calif., October 1, 1925, for 0.37 cubic foot per second and 100 acre feet per annum from Woods Valley Creek in Section 14, T 11 S, Range 2 W for domestic and irrigation of 30 acres in Section 14. Estimated cost $2,000.

Permit No. 2267, Application No. 4421 (San Luis Obispo County). Issued to Duane R. Hall, Paso Robles, Calif., October 10, 1925, for 0.55 cubic foot per second from Salinas River, in Section 4, T 27 S, R 12 E, for irrigation of 44.35 acres in Section 4. Estimated cost $1250.

Permit No. 2268, Application No. 4635 (San Joaquin County). Issued to Alfred S. and Wm. C. Ferguson, Stockton, Calif., October 10, 1925, for 12.21 cubic feet second from Old River and Western Canal in Sections 20 and 29, T 1 S, R 4 E, for irrigation of 977.1 acres near point of diversion. Estimated cost $11,000.

Permit No. 2273, Application No. 4454 (San Joaquin County). Issued to J. A. Bennett, Walnut Creek, Calif., October 14, 1925, for 1.51 cubic feet per second, from Potato Slough in Section 24, T 3 N, R 4 E, for irrigation of 121.1 acres in Section 24. Estimated cost $1000.

Permit No. 2274, Application No. 4637 (San Joaquin County). Issued to Caroline Moran, Stockton, Calif., October 14, 1925, for 12.44 cubic feet per second from Middle River in Sections 12 and 23, T 1 S, R 5 E, for irrigation of 995.5 acres near point of diversion. Estimated cost $9,000.

Permit No. 2277, Application No. 4460 (San Joaquin County). Issued to River Junction Reclamation District No. 2064, care Harmon S. Bonte, Balfour Bldg., San Francisco, Calif., October 16, 1925, for 72.29 cubic feet per second, from Stanislaus River in Section 9, T 3 S, R 7 E, for irrigation of 5783 acres in said district. Estimated cost $7,500.

Permit No. 2281, Application No. 4662 (San Joaquin County). Issued to Mrs. Susie Moran, Stockton, Calif., October 17, 1925, for 1.24 cubic feet per second, from Grant Line Canal in Section 26, T 1 S, R 4 E, for irrigation of 99.2 acres near point of diversion. Estimated cost $1500.

Permit No. 2282, Application No. 4350 (Sacramento County). Issued to N. D. Hack, Sacramento, Calif., October 19, 1925, for 1.25 cubic feet per second, from Sacramento River in Section 24, T 7 N, R 4 E, for irrigation of 100 acres near point of diversion. Estimated cost $1,000.

Permit No. 2285, Application No. 4501 (Yolo County). Issued to John Kneppel, Clarksburg, Calif., October 21, 1925, for 0.45 cubic foot per second from Sacramento River in Section 21, T 7 N, R 4 E, for irrigation of 36 acres near point of diversion. Estimated cost $2000.

Permit No. 2290, Application No. 2195 (Plumas and Sierra County). Issued to Feather River Power Company, San Francisco, Calif., October 23, 1925, for 55,000 acre feet per annum from Bucks Creek in Sections 33 and 29, T 24 N, R 7 E, for power purposes in Section 30, T 24 N, R 7 E, and Section 29, T 24 N, R 6 E. 106,949 theoretical horsepower to be developed. Estimated cost $7,700,000.

Permit No. 2291, Application No. 3889 (Plumas County). Issued to Feather River Power Company, San Francisco, Calif., October 23, 1925, for 23,000 acre feet per annum from Bucks Creek, in Section 19, T 24 N, R 7 E, for power purposes in Section 30, T 24 N, R 7 E, and Section 29, T 24 N, R 6 E, 106,949 theoretical horsepower to be developed.

Permit No. 2292, Application No. 4441 (Plumas County). Issued to Feather River Power Company, San Francisco, Calif., October 23, 1925, for 40,000 acre feet per annum from Bucks Creek in Section 19, T 24 N, R 7 E, for power purposes in Section 30 T 24 N, R 27 E, and Section 29, T 24 N, R 6 E, 106.949 theoretical horsepower to be developed.

Permit No. 2293, Application No. 4453 (Plumas County). Issued to Feather River Power Company, San Francisco, Calif., October 23, 1925, for 35 cubic feet per second and 1,000 acre feet per annum from Milk Ranch Creek and 3 unnamed tributaries in Sections 1, 12 and 15, T 24 N, R 6 and 7 E., for power purposes in Section 30, T 24 N, R 7 E, and Section 29, T 24 N, R 6 E, 12,998 theoretical horsepower to be developed.

Permit No. 2294, Application No. 4491 (Plumas County). Issued to Feather River Power Company, San Francisco, Calif., October 23, 1925, for 175 cubic feet per second, from Bucks Creek and Grizzly Creek in Sections 29 and 19, T 24 N, R 7 E, Section 1, T 23 N, R 6 E, for power purposes in Section 30, T 24 N, 7 E, and Section 29, T 24 N, R 6 E, 62,759 theoretical horsepower to be developed.

Permit No. 2295, Application No. 4598 (Plumas County). Issued to Feather River Power Company, San Francisco, California, October 23, 1925, for 105 cubic feet per second from Grizzly Creek in Section 1, T 23 N, R 6 E, for power purposes in Section 29, T 24 N, R 6 E. 29,627 theoretical horsepower to be developed.

Permit No. 2296, Application No. 4599 (Plumas County). Issued to Feather River Power Company, San Francisco, Calif., October 23, 1925, for 40 cubic feet per second from Milk Ranch Creek and 3 unnamed tributaries in Sections 1 and 12, T 24 N, R 6 E, for power purposes in Section 30, T 24 N, R 7 E, and Section 29, T 24 N, R 6 E. 14,854 theoretical horsepower to be developed.

Permit No. 2298, Application No. 438 (San Bernardino County). Issued to Mojave River Irrigation District, Victorville, Calif., October 28, 1925, for 30,000 acre feet per annum from Deep Creek and West Fork Mojave River in Sections 17 and 18, T 3 N, R 3 W, for irrigation of 26,878.36 acres in said district. Estimated cost $1,700,000.

Applications Filed

Among the applications for permit to appropriate water filed with the State Department of Public Works, Division of Water Rights, (California) during the month of October were the following:

Application No. 4792 (Placer County). Lake Tahoe Company, care H. A. Kluegel, Balfour Building, San Francisco, Calif., for 12.5 cubic feet per second, 200 ac. ft. per annum from Ward Creek tributary to Lake Tahoe. To be diverted in Section 23, T 15 N, R 16 E, M.D.M. For generation of hydro-electric energy and domestic purposes.

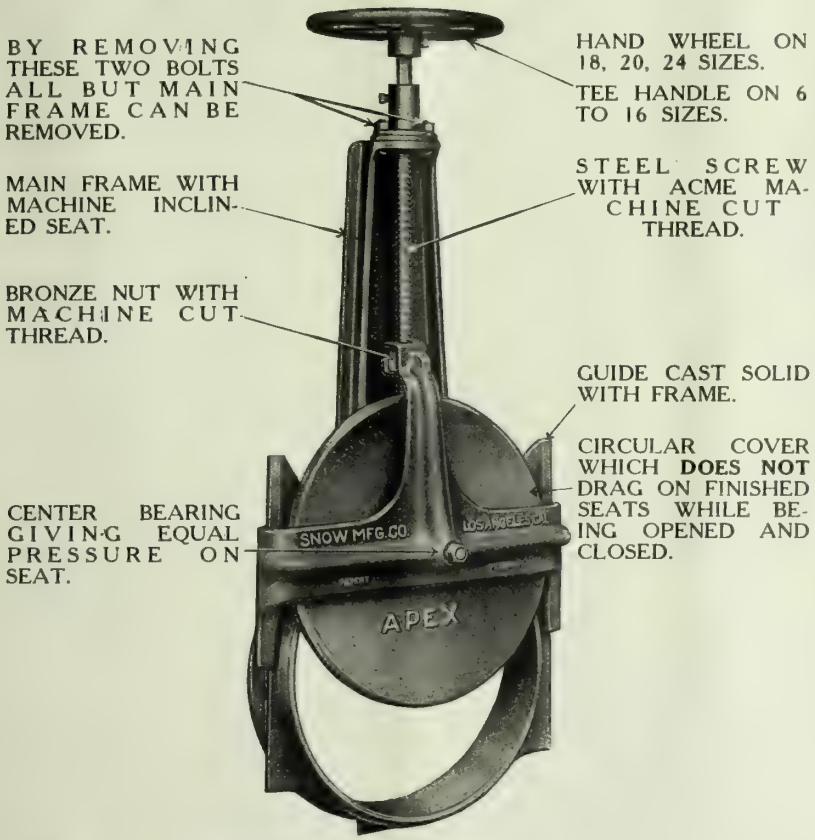
Application No. 4797 (Imperial County). Webster N. Kenyon, P. O. Box 22, Westmorland, Calif., for 1.87 cubic feet per second from underground water tributary to San Felipe Creek Watershed, to be diverted Tract 49, T 13 S, R 9 E, S. B. M. for irrigation on 160 acres in Tract 53, T 13 S, R 10 E, S.B.M.

Application No. 4799 (Placer County). Victor T. Mathews, Cisco, Calif., (1) 200 cubic feet per second, (2), (3), (4) and (5) 200,000 acre feet per annum from North Fork American River and Tributaries, Big Valley and Granite Creeks tributary to Sacramento River, to be diverted in (1) Section 2, T 15 N, R 11 E, M.D.M., (2) Section 30, T 16 N, R 13 E, M.D.M., (3) Section 19, T 16 N, R 13 E, M.D.M. (4) Section 15, T 16 N, R 13 E, M.D.M., and (5) Section 30, T 14 N, R 17 E, M.D.M. for irrigation of 30,000 acres in T 11, 12, 13 N, and R 4, 5 and 6 E, M.D.M.

Application No. 4800 (Siskiyou County). Thos. M. Park, care H. H. McPike, 332 Pine Street, San Francisco, Calif., for 3,000 cubic feet per second from Klamath River to be diverted in Section 10, T 46 N, R 12 W, M.D.M. for generation of hydro-electric energy in Section 18, T 46 N, R 12 W, M.D.M. 54,545 T.H.P. to be developed. Estimated cost $6,000,000.

Application No. 4801 (Siskiyou County) Thos. M. Park, care of H. H. McPike, 332 Pine street, San Francisco, Calif., for 3,000 cubic feet per second from Klamath River, to be diverted in Section 5, T 16 N, R 8 E, H. M. For generation of hydro-electric energy in Section 6, T 11 N, R 8 E, H. M.,

·SNOW·
IRRIGATION APPLIANCES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T. H. P. to be developed 34,091. Estimated cost $4,000,000.

Application No. 4805 (Placer County) Victor T. Mathews, Cisco, Calif., for 200 cubic feet per second and 200,000 acre feet per annum from North Fork of American River and tributaries, tributary to Sacramento River, to be diverted in Sections 30, 19 and 15, T 16 N, R 13 E, M. D. M. and Section 30, T 14 N, R 17 E, M. D. M., for generation of hydro-electric energy in Section 2, T 15 N, R 11 E, M. D. M., 18,182 T. H. P. to be developed. Estimated cost $3,000,000.

Application No. 4807 (San Bernardino County) Water Conservation Association, Riverside, Calif., for 250,000 acre feet per annum from Santa Ana River and (or) tributaries, tributary to Pacific Ocean to be diverted in Sections 9, 10, 11 and 12 T 1 S, R 3 W, S. B. M., Sections 4, 7, 8 and 9, T 1 S, R 2 W, S. B. M., Sections 13, 22, 23, 24, 25, 26, 27, 34, T 1 N, R 2 W, S. B. M. and Sections 8, 17 and 18, T 2 N, R 1 W, S. B. M., for agricultural purposes on 52,640 acres.

Application Number 4811 (Sacramento County) Fair Oaks Irrigation District, Fair Oaks, Sacramento County, Calif., for 7 cubic feet per second from American River tributary to Sacramento River to be diverted in Section 18, T 9 N, R 7 E, M. D. M., for irrigation of 3800 acres. Estimated cost $30,000.

Application No. 4812 (Mariposa County) James I. East, care of Ohm and Raab, 517 E. Market street, Stockton, Calif., for 3 cubic feet per second and 500 acre feet per annum from Mariposa Creek tributary to San Joaquin River, to be diverted in Section 1, T 8 S, R 16 E, M. D. M., for agricultural purposes on 350 acres in Section 1 and 2, T 8 S, R 16 E, M. D. M.

Application No. 4817 (Placer County) Fred Dewhirst, care of F. Emerson Hoar Co., 955 Market street, San Francisco, Calif., for 300 cubic feet per second and 100,000 acre feet per annum from Bear River tributary to Feather River to be diverted in Section 2, T 13 N, R 8 E, M. D. M. For agricultural and domestic purposes on 60,000 acres.

Application Number 4818 (Placer County) Edward F. Walker, Glendale, Calif., for 15 cubic feet per second and 200 acre feet per annum from Ward Creek tributary to Lake Tahoe to be diverted in Section 22, T 15 N, R 16 E, M. D. M., for power purposes, 852 T. H. P. to be developed.

Application No. 4820 (San Joaquin County) Walter A. Perry, Stockton, Calif., 2.53 cubic feet per second from Old River tributary to San Joaquin River, to be diverted in Section 29, T 1 S, R 6 E, M. D. M., for irrigation purposes on 203 acres. Estimated cost $4000.

OREGON

The following list includes the more important applications as filed in the office of Rhea Luper, State Engineer of Oregon, for the last month for which records are available:

Calvin Puderbaugh of Fruita, covering the appropriation of water from Mahogany Creek for irrigation of 20 acres, and domestic purposes in Wallowa County.

H. W. Vogel of Oretown, covering the appropriation of water from Commons Creek for development of power in Tillamook County.

George E. Frost of Portland, covering the appropriation of water from Spruce Spring for domestic purposes in Lincoln County, at a cost of $2,200.

Shoemaker Brothers of Mitchell, covering the appropriation of water from Mill Creek for supplemental irrigation of 139.67 acres in Wheeler County.

L. A. Whitley of Trail, covering the appropriation of water from Elk Creek for irrigation of 13 acres in Jackson County.

Duhaime Brothers of Burns, covering the appropriation of water from Poison Slough and Foley Slough for irrigation of 160 acres in Harney County.

George D. Williams of Ashland, covering the appropriation of water from Jenny Creek for irrigation of 59.7 acres in Jackson County, at a cost of $500.

T. J. Duhaime of Burns, covering the appropriation of water from Poison and Foley Sloughs for irrigation of 160 acres in Harney County.

Frank Obenchain of Bly, covering the appropriation of water from Merrill Creek for irrigation of 74.4 acres in Klamath County.

Jettie Bolos of Chico, California, covering the appropriation of water from Kelly Creek for irrigation of 27 acres in Josephine County, Oregon.

Henry L. Corbett of Portland, covering the appropriation of water from Jack Creek for development of 20.9 theoretical horsepower in Jefferson County, at a cost of $1,000.

M. J. Lee, Trustee, of Canby, covering the appropriation of water from Molalla River for irrigation and power purposes in Clackamas County.

C. T. Darley of Klamath Falls, covering the appropriation of water from Pearl Spring for irrigation of 160 acres and domestic purposes in Klamath County.

Edward E. Heslin of Fairview, covering the appropriation of water from an unnamed stream for irrigation of 19.72 acres in Multnomah County.

George A. and Violet C. Fuller of Perry, covering the appropriation of water from Gordon Creek for irrigation of 80 acres in Union County.

City of Wallowa, covering the appropriation of waste and seepage water from C. W. Moore Ranch for supplemental irrigation of 132 acres in Wallowa County.

George R. McKimens of Mohler, covering the appropriation of water from South Fork of Kebbe Creek for domestic and irrigation purposes in Tillamook County.

Mac-A-Wauna Company of Mosier, covering the appropriation of water from Mosier Creek for irrigation of 16.4 acres in Wasco County, at a cost of approximately $4,000.

City of Baker, covering the appropriation of water from Pine Creek and South Prong of Pine Creek for storage of 1380 acre feet in Pine Creek Reservoir; and the appropriation of water from Pine Creek and its tributaries, together with the stored water for municipal purposes, at a cost of $60,000.

Frank Waldon of Prairie City, covering the appropriation of water from John Day River for irrigation of 25 acres in Grant County.

R. W. Cary of Portland, covering the appropriation of water from Bagsby Hot Springs, and Hot Springs Fork, including Nohorn and Whetstone Creeks for development of power and summer resort purposes.

A. C. Gienger of Chiloquin, covering the appropriation of water from Williamson River and Spring Creek for domestic purposes in Klamath County, at a cost of $10,000.

Joseph R. Keep of Portland, covering the appropriation of water from White River, and from Frog Lake Creek, Clear Creek, and water stored in reservoirs for power, irrigation and domestic purposes in Hood River and Wasco Counties respectively.

Fred Haines of Burns, covering the appropriation of water from Poison Slough for irrigation of 160 acres in Harney County.

Fred Train of Copco, California, covering the appropriation of water from Spring and Falls Creek for domestic and irrigation of 80 acres in Jackson County.

Power Developments

Twenty-four applications for permit or license under the Federal water power act were filed with the Federal Power Commission during the ten weeks period ended November 7, 1925. The following are the applications affecting power developments in the west:

No. 646. The Red River Lumber Company has applied for a preliminary permit for a power development in Hat Creek, within the Lassen National Forest, in Shasta County, California. The company plans to construct a dam of sufficient height to divert 200 second feet of water from the creek through a flume to a power house which, with other appurtenant structures, will be built about 3.4 miles from the dam site. The developed power will be used for manufacturing purposes.

No. 647. The City of Los Angeles has made application for a preliminary permit covering an extensive proposed development on the Colorado River, in San Bernardino County, California, and Yuma and Mohave Counties, Arizona, comprising a reservoir, dams, waterways, and power plants, designed to develop 108,000 horsepower of electric energy. It is proposed that construction work be carried on in conjunction with any plans which the Bureau of Reclamation may adopt for irrigating and reclaiming lands adjacent to the Colorado River. The City proposes to operate this project in conjunction with a project at Boulder Canyon for which application is now pending before the Commission. The developed power would be used for public-utility purposes. Action on this application has been suspended under the Commission's order of October 28, 1925, relating to all projects affecting the Colorado River.

No. 648. Messrs. Jas. B. Knight, Fred M. Kay, J. L. Stone, W. H. Haw, Frank Breeden, and David Wilson, have applied for a preliminary permit for a power development in New River, in Trinity County, California. A 50-ft. dam, having a crest of 250 ft. in length would divert water from the river through a conduit about 12 miles in length to a power house to be built near the mouth of the river and to have an installed capacity of 5,000 horsepower. The developed power would be used in lumbering and mining operations.

No. 652. The Southern Sierras Power Co. has applied for a license for a 110-kilowatt transmission line about a mile and a half in length in the Inyo National Forest, Mono County, California, to connect a switch structure on the Owens River Gorge with the company's main transmission system.

No. 653. The Liberty Montana Mines Co. has applied for a license covering a power project in South Boulder Creek in Madison County, Montana, proposing to develop 300 horsepower for use in mining operations. The installation would include a 15-foot

dam creating a small reservoir, a conduit about 4-5 mile in length, a power house, and a transmission line leading to the company's mill.

No. 660. Mr. Fred T. Colter, claiming to act on behalf of the State of Arizona, has applied for a preliminary permit for power and irrigation development on Colorado River, in Coconino and Mohave Counties, Arizona. A storage dam, to impound approximately 52,000,000 acre-feet of water, is proposed at Glen Canyon dam site. A power, storage, and diversion dam is proposed at Bridge Canyon dam site, to be used to supply water for irrigation by gravity. Action on this application is suspended under the Commission's order of October 28, 1925, relating to all Colorado River cases.

No. 661. The Board of Directors of State Institutions of the State of Arizona has applied for a preliminary permit for a development in Mohave County, Arizona, at Bridge Canyon dam site, in the Colorado River. It is said that the State proposes to construct a dam which can be raised to an approximate height of 1,000 feet, for the purpose of impounding water for irrigation, and for reducing flood danger. The power developed would be utilized for irrigation pumping. Action on this application is suspended under the Commission's order of October 28, 1925, relating to all projects affecting the Colorado River.

No. 662. The Best Flume & Power Company has applied for a license for a development on Pine Creek, in Sublette County, Wyoming, to be used in supplying the town of Pinedale, Wyo., with power.

No. 665. The Utah Power & Light Company has applied for a license for a constructed project in Utah County, Utah, on Santaquin Creek. The developed power is used for public utility purposes.

No. 666. Mr. Thomas M. Park has applied for a preliminary permit for a power development in Siskiyou County, California, five miles east of Happy Camp. Three thousand second feet of water would be diverted from Klamath River without use of dam or obstruction, for the generation of power for the operation of mining camps, and would be returned to the river farther downstream.

No. 668. The Southern California Edison Company has applied for a preliminary permit for a power development project in Colorado River, near Topock, Arizona, proposing to build a concrete dam in Mohave Canyon approximately 168 ft. in height, at which power would be developed for use in public-utility purposes.

Addison Smith on Reclamation

(*Continued from Page 15*)

ly five hundred thousand people are now living on these lands. Many of them have acquired competency, and they purchase annually more than $500,000,000 worth of manufactured goods, mostly from other states.

Some projects were undertaken which were unfeasible from an engineering standpoint, which made the cost excessive. Others were in localities where soil and climatic conditions were not favorable. But for these mistakes, we would not now be confronted with the failures that have embarrassed those advocating the federal reclamation policy.

Yet on many of the projects this year the gross value of average production per acre will exceed $100. On some projects, specializing in the growing of fruit and potatoes, the gross value of the crop per acre will exceed $1000.

We have assurance that the failures of the past will not be repeated. Under the law based on the Fact Finders' report, a careful selection of settlers is required, based on their experience and their financial ability to equip an irrigated farm unit. It is also required that no project shall be undertaken until a careful survey has been made by the Department of Agriculture with reference to the character of the soil.

INCREASE in population is not the only factor that demands consideration from the people of America and emphasizes the need for serious thought on the matter of going further than we have yet gone, and extending land reclamation.

The shrinkage and abandonment of approximately 1,000,000 acres of eastern crop lands annually is one of these factors.

The fact that we produce only about one-fifth of the sugar consumed by our vast and increasing population should still further convince us of the wisdom of opening up to settlement greater areas of western arid lands admirably adapted to the cultivation of the sugar beet.

There should go hand in hand with the extension of reclamation the wider application of co-operative marketing. By this combination we should have the wisest undertaking that has ever been devised in the interest of farming and allied industries.

Reduction of cost of production, standardization of commodities, orderly distribution, properly regulated plantings and other methods of efficient co-operative marketing management are but a few of the profit sharing benefits that would accrue.

It is an established fact that land reclamation and co-operative marketing are rather closely allied. The expansion of one automatically extends the usefulness and service of the other.

In their messages and public utterances on the subject the President and the Secretary of Agriculture have shown themselves to be earnest champions of the benefits to be derived by the farmer through co-operative organization. The present Division of Co-operation, in the Department of Agriculture, has been and is rendering invaluable service to co-operatives and to farmers contemplating such organizations.

The expansion and enlargement of this division, now in charge of such well-known experts as Lloyd S. Tenny, C. L. Christenson, and A. W. McKay, will probably be effected during the present session of Congress.

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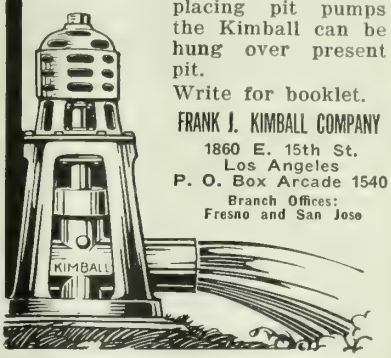

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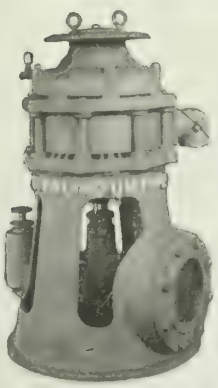

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Editorial Jottings About Current and Forthcoming Feature Articles, Dealing With Practical Problems of Hydraulics, and the Men Who Have Written Them

EXPERIENCE in many different parts of the world, and contact with the irrigation activities of all continents, have given THOMAS H. MEANS a perspective which he utilizes to good advantage in his article in this issue on "Irrigation in the Four Quarters of the Earth."

France, Algiers, Tunis and many parts of Egypt were visited by Mr. Means early in his engineering experience. He spent nine years in the United States Department of Agriculture, in the establishment of soil surveys, the investigation of irrigation and drainage lands, and making reports on the agricultural possibilities of special regions. It was during this service for the Department that he went to Europe and northern Africa and made a study of land reclamation as practiced there.

Six years were invested in the U. S. Reclamation service, part of which time Mr. Means spent in the general examination of all projects. He was later in charge of operation on the first reclamation project that delivered water—the Truckee-Carson project.

For the latter half of his thirty years of professional experience, Mr. Means has been in San Francisco in private practice. During this period he has become well known for his engineering judgment in constructing and advising capacities. He has built a number of public and private irrigation projects, and at the present time his work consists largely of investigations and construction work for irrigation and reclamation districts.

EVERETT N. BRYAN, chief deputy in the office of Edward Hyatt, Jr., chief of the Division of Water Rights of the California Bureau of Public Works, this month contributes the first of a series of articles that will come from California irrigation officials discussing aspects of state control and development of water. Mr. Bryan writes on "The Importance of the Orderly Establishment of Water Titles." Other experts in the office of the Division of Water Rights are to contribute future articles dealing with various important and interesting phases of the work of the California state office in aiding and directing water use.

Mr. Bryan was brought up in California, and was graduated from the University of California in 1907. Since 1909 he has been engaged continuously in irrigation and hydroelectric work. Positions which he has held in the irrigation industry include: assistant engineer, Turlock irrigation district; superintendent, Modesto irrigation district; chief engineer for T. K. Beard, constructor of highways, reservoirs and irrigation systems; chief engineer, Waterford irrigation district. He has also spent considerable time in private practice, doing valuation work and making water supply and irrigation studies. He entered the office of the California Division of Water Rights as hydraulic engineer, was subsequently made office engineer, and is now Deputy Chief of the Division.

ADDISON T. SMITH is a representative in Congress from Idaho, his home being at Twin Falls in that state. He was born in Ohio, and educated in Washington, D. C., where he took his law degrees and was admitted to the bar. He served in the senate as a committee clerk for several years, removed to Idaho in 1900, was admitted to the bar there, and returned to Washington as secretary to Senator Shoup of Idaho and his successor, Senator Heyburn. In 1906 he was appointed by President Roosevelt as register of the land office at Boise, Idaho, and

EVERETT N. BRYAN

in 1913 was chosen a member of Congress, serving in every Congress from the 63rd to the 69th, which is now in session. His interest in irrigation and reclamation was aroused by his early contacts with the land and water problems of the west, and after he returned as a law-maker to the scenes which were so familiar to him as a young man, he exerted his efforts in the direction of wise irrigation legislation. He is co-author with Senator McNary of the co-operative reclamation measure introduced before the last congress, and known as the Smith-McNary bill. Since 1923, he has been chairman of the house committee on irrigation and reclamation.

IRVING C. HARRIS is a Los Angeles consulting engineer, associated with William S. Cone in the partnership of Cone & Harris. He was graduated in electrical engineering, in 1900, from what is now the California Institute of Technology. For five years Mr. Harris was Engineer in Charge of the power division of the Salt River Project of the Reclamation Service, during which time he had charge of the construction and operation of the power plant at the Roosevelt Dam and other power plants, sub-stations, transmission lines and pumping plants on the projects. Leaving the Salt River Project in 1904, he spent nearly three years traveling in the East on a special assignment for the Service, as Engineer in Charge of Inspection. This work involved the inspection of water and power structures manufactured for use by the service. His present work includes examination, reporting, designing and supervision of power development and irrigation works.

CARLETON M. JOY, who has written the brief account of the visit of the senate committee on irrigation and reclamation on the Lower Colorado River, is connected with the Imperial Irrigation District. Thomas Brooks is in charge of domestic service and supply for the Los Angeles Bureau of Water Works and Supply. Charles P. Williams is a consulting engineer who is well acquainted with the conditions and problems of the Lower Rio Grande Valley. George C. Jewett is president of the Federal Farm Loan Bank at Spokane, Washington. Hugh Crane is a staff contributor whose name is regularly seen in these columns.

THE JANUARY issue will be full of interesting articles dealing in a practical way with hydraulic developments in many parts of the west. While it is not a sectional journal, MODERN IRRIGATION'S interest in the allied water development industries makes it primarily a publication of the western half of the United States. It is fast coming to have a wide acceptance over all of this great territory, and the character of the contents of the January number will testify as to the variety of its editorial interest from the standpoint of geography.

Idaho, Nebraska, Texas, Oregon, and California will be represented by articles in the first number in 1926. The Idaho article will deal with developments at American Falls; and the Texas feature will describe what is being done by the Hidalgo County Water Improvement District No. 4, on the lower Rio Grande. This feature will be especially interesting in view of the discussion appearing in this issue in which Mr. Williams describes the peculiar problems of drainage which confront water companies on the Lower Rio Grande Valley.

B. J. Seger, of Scottsbluff, Nebraska, whose article in this issue introduces the subject of credit for irrigation districts, will conclude the series in the January number. Another article will deal with developments in the Imperial Valley of California, and a feature prepared by Arthur P. Davis, internationally known engineer, will describe the work undertaken by the East Bay Municipal Utility District on the great Mokelumne River project. Oregon will be represented by a discussion of "Irrigation and Power," by Franklin J. Griffith, of Portland.

MODERN Irrigation

The Magazine of Applied Hydraulics

Vol. II JANUARY, 1926 No. 1

In this issue:

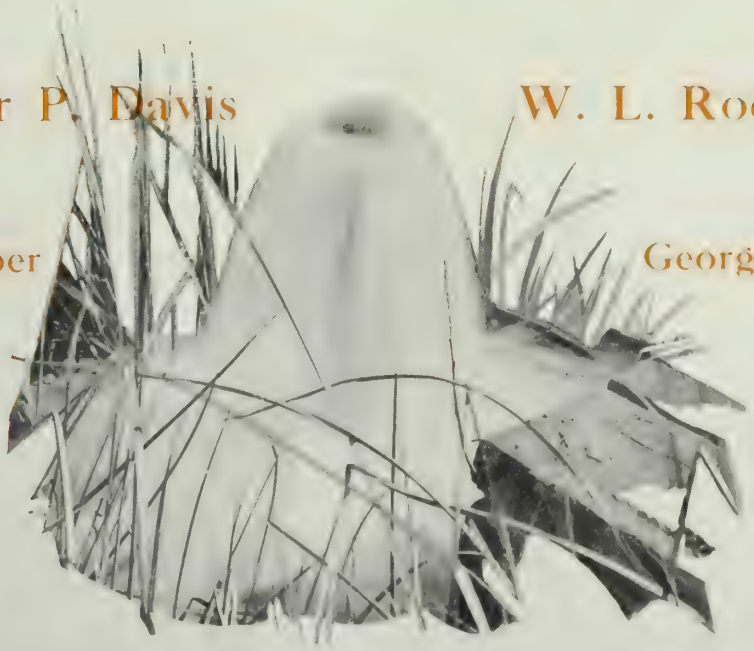
Frank Adams

Arthur P. Davis

W. L. Rockwell

Rhea Luper

George M. Neel



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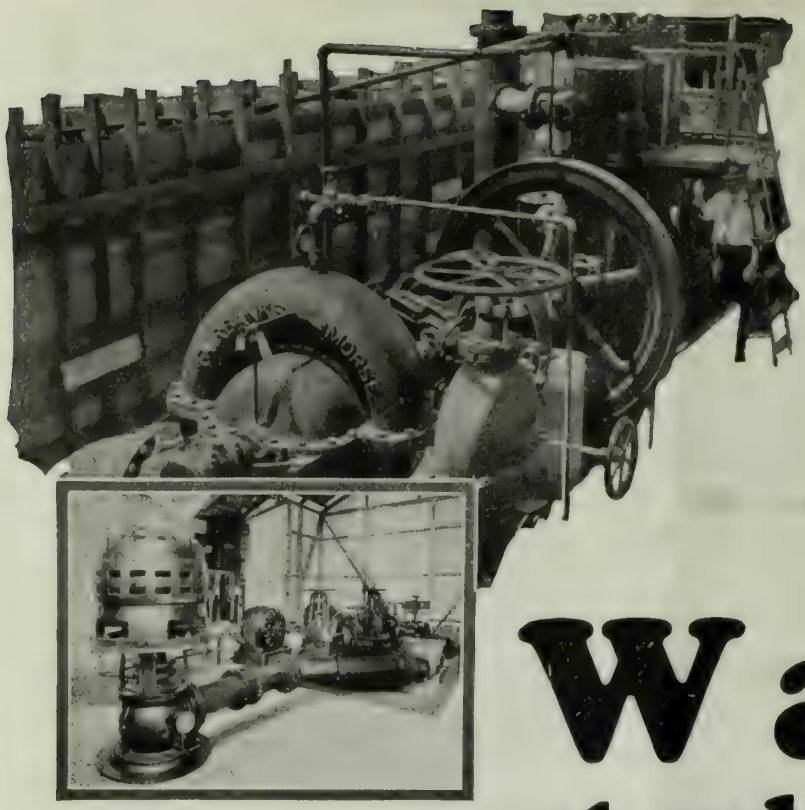

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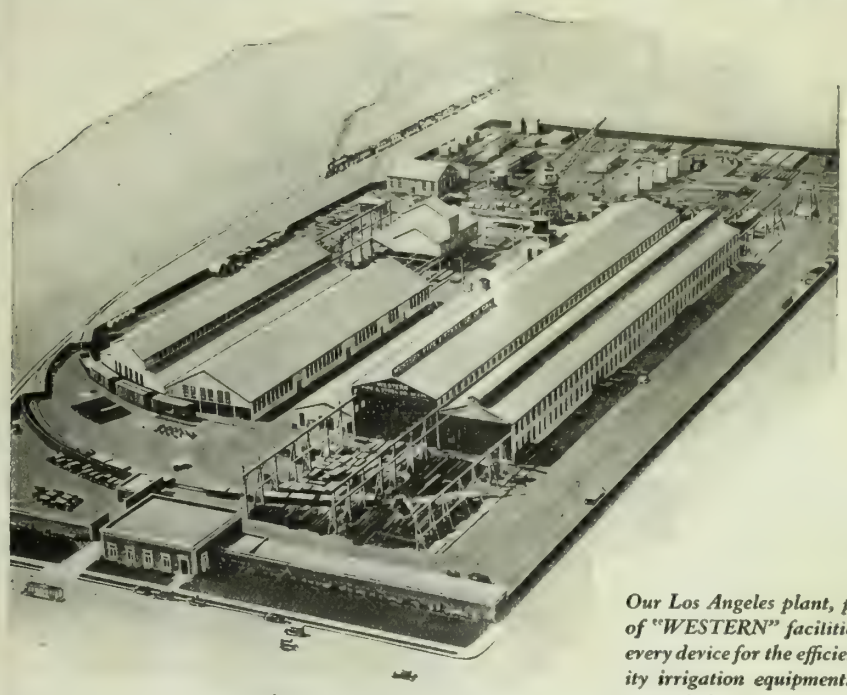

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New Era of Water Development is Predicted

M. E. Layne Gives Reasons for Active Western Irrigation Development. Bonus for Employees Distributed

THAT 1925 has shown greater progress in the development of well irrigation than in any previous year, excepting the peak war period and that 1926 is destined to eclipse 1925 both in volume of orders and introducing of pump improvements, is the assertion of M. E. Layne, President of Layne & Bowler Corporation of Los Angeles, manufacturers of Layne & Bowler Turbine Pumps.

It is his opinion that irrigators —recognizing the fact that they are liable to have a water shortage—will no longer delay the installation of additional plants and that the irrigation season will this year begin at least eight weeks before the normal commencement time.

When asked to state the fundamental reasons for the particularly impressive growth of his organization during the past year, Mr. Layne stated:

"The general impression is that our growth is wonderful. But this growth is easily understood when you consider the fact that all of our earnings have remained in the business, and out of the forty-two years of continuous growth of this business only three dividends have ever been declared. These three dividends were paid at the close of and following the war (1918, 9 per cent; 1919, 9½ percent; 1920, 10 percent), while during the slump period (1921-2-3) the factory was operated without profit—due mainly to the depreciation in value of material on hand, and inability to rapidly reduce and adjust the high salary overhead built up by the war demands. (The war price of common and skilled labor has not been reduced, but has slightly increased).

"Our overhead has been greatly reduced for the period of 1924 and 1925 by reason of increased volume of business—making it possible for us to sell our highly refined product at a greatly reduced price, and the further fact that we have not paid any dividends since 1920 has put us in a position to discount our bills,purchase our materials in larger quantities, give liberal terms to our customers, and to sell and install our plants at the lowest possible price.

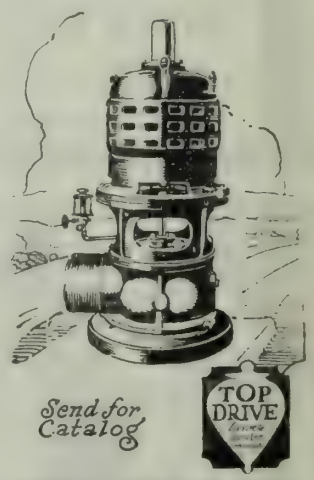
"The net earning of our company for 1925 was approximately 9 per cent. The stockholders of the corporation are sharing this earning with their employees in the following way:—All employees drawing less than $200 per month have received a bonus of 6 per cent on their total 1925 salary; all employees earning from $200 up to and including $300 per month have received 5 per cent on their 1925 salary; and all employees earning over $300 per month have received a 4 per cent bonus on their 1925 salary. This leaves to the stockholders an earning on their investment of a smaller percentage than if they had placed their capital in real estate loans or other securities.

"The above bonus is given in order, first: to be fair to our employees; second, to retain them in the business, realizing that the corporation's growth and the customer's profits depended on long life and high efficiency of our product—which is only made possible through the efforts of skilled and experienced man-power.

"During our forty-two years of progressive operation we have never had a strike among our employees. This is conclusive evidence that they appreciate their relationship with us.

"Our corporation also protects each member of the entire force, regardless of age, with $8000.00 worth of individual insurance. Should their death be caused by accident, while on duty, the relatives of the deceased will receive $5000 covered by accident insurance, plus $3000 covered by straight life insurance. Should death occur from causes other than accident the relatives of the deceased will receive $3000. Each of our employees is protected by accident compensation insurance, all premiums being paid by the company without cost to the employee."

Mr. Layne was asked, what, in his belief, was the cause of his firm's reduction in overhead and if it was as low or lower than that of competing companies. He replied: "When considering our large volume of business, the percentage of overhead costs is less than one-half of the costs that prevailed during our developing and wartime period, which strikingly reflects the economy of quantity production. Our overhead is far below that of competing companies which are not favored with equal volume of business we are enjoying."



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GEORGE C. PARDEE

President of the East Bay Municipal Utility District, whose great project for increasing the water supply of the nine municipalities which it serves is described in this issue. Many men attain eminence in their chosen profession; Dr. Pardee is the unusual man who has established an enviable reputation in many fields of endeavor. He was a prominent surgical specialist before he was called to public service. As a leader in public life he became Governor of California. Today he is matching his record of success in these two lines with a career of achievement as a business executive.

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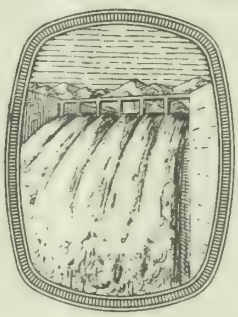
The Magazine of Applied Hydraulics



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The Progress *of* Irrigation

POTENTIALLY the most significant action taken in irrigation on the American continent during December was the passage, by the Congress of the Republic of Mexico, of the Irrigation Bill. This bill was approved by the Chamber of Deputies on December 10th, and enacted unanimously by the Senate on December 24th.

The law declares that irrigation is a public utility, and creates a federal commission for carrying out extensive irrigation developments in all parts of the nation. In such a provision there lurk innumerable dangers. Applied to conditions in the United States it would be farcical, for in this country irrigation under local management moves forward two steps while the federal administration of water development is accomplishing one with considerable difficulty.

But it is possible that such a system may mean the advent of a lively period of irrigation progress in the Mexican republic. President Calles, for all his apparent phobia against foreigners, is evidently sincerely interested in the welfare of the agricultural classes, and cognizant of the need for appropriating foreign skill and experience. Mexico has a number of excellent agricultural schools in operation, and is building more in different parts of the country. The plan of the administration is eventually to have thirty of these schools, with an attendance of approximately 7500 students, who will complete their training by practical experience on irrigated projects in the United States and other countries, returning to their own country able to assume the leadership in irrigation development.

THE NEW Mexican law provides that the present owners of irrigable lands are given the first opportunity to carry out irrigation works and develop the lands themselves. If they do not do this, the federal irrigation commission is empowered to take over and irrigate the lands, irrespective of the owners' desires, and to compensate the owners by returning to them a smaller part of the lands thus made more valuable through irrigation.

Developments to be undertaken within the next three years, it is announced, will entail an expenditure of some sixty millions of pesos ($30,000,000). President Calles has outlined a plan for the development of approximately twenty large and important tracts of land. He has arranged with a well-known American engineering company to design and

supervise the construction of the major portion of this program. Preliminary work has already been started by the American company.

The Mexican president is desirous of developing Mexican nationals in all phases of irrigation work, both technical and otherwise, and has stipulated that the American company must form a Mexican corporation for the purpose of carrying out these enterprises, and that at least four-fifths of the engineers and practically all of the non-technical labor must be Mexicans.

The American engineering firm, commenting on the magnitude and significance of the contemplated program, remarks: "It is regarded as the most important forward stride ever taken by the Republic of Mexico for its fundamental advancement."

ANOTHER important step in the advance of irrigation was taken when Secretary Work, on December 19, signed on behalf of the United States the contract which authorizes the commencement of construction work on the Kittitas project, in Washington. This step was epochal not simply because it sets in motion a great new reclamation project, estimated to cost some ten million dollars for completion, but has a significance that will extend far beyond the confines of the lands affected and even beyond the state of Washington, ushering in a new principle of reclamation development.

For the contract which was executed at the capital had already been signed by Governor Hartley of Washington, and involves a co-operative venture between the national and state governments, in which the state assumes the duty and responsibility of promoting the development and settlement of the Kittitas project after its completion. The work contemplated by the contract is to be done, it provides, in close co-operation between the Secretary of the Interior and the officials of the state.

The Kittitas project is itself a considerable undertaking, and one to which the people of Washington have been for a long time looking forward. It will develop the Kittitas division of the Yakima reclamation project, including about 70,000 acres of lands. Before it is completed it will cost, according to estimates, about $11,000,000. In newspaper comments from Washington, with few exceptions, there is evident a great spirit of rejoicing and optimism as a result of this decision to prosecute the undertaking without delay.

But the precedent set by the agreement between the state and the federal government will have a more momentous importance, either for weal or woe, far beyond the direct effects of the single project. The heads of the reclamation bureau have been advocating for a long time that the settlement of the reclamation projects was a matter for local supervision, for which the state government, as the agency most directly concerned and best able to assume control, ought to be responsible. That the state ought to have some such measure of responsibility has been urged, also, by many informed observers of the difficulties of reclamation.

That there is opposition to such a plan, from eminent sources, is true. Rhea Luper, state engineer of Oregon, attending a national conference on land settlement policies at Washington in December, stated the case for the opponents of the state-federal co-operation policy when he emphatically declared that the branch of the government that undertakes a project ought to be responsible for carrying it through to completion. Speaking for his state, he told the conference that Oregon does not believe the state should assume the obligation of financing settlers; that reclamation of large areas is a work for federal, rather than state, agencies, and that inasmuch as the reclamation fund is received directly from the states in which the projects lie, taxation for the purpose of extending state financial aid to settlers would be unreasonable.

There would seem to be little doubt, however, that there is a decided opinion in favor of trying out this new scheme of solving the most perplexing of reclamation's many problems, and the attention and interest of all reclamation interests will therefore be centered on the future career of the Kittitas project.

JUST AS this issue goes to press, the complexion of affairs with regard to the Colorado River is materially changed by the announcement that Hubert Work, Secretary of the Interior, has submitted to the senate committee on irrigation and reclamation a report in which he recommends a plan of development identical in essential details with that proposed in the Swing-Johnson bill. This turn of affairs should bring new and significant factors into the interplay of political considerations which surround the Colorado River and the various plans for its development. It is hailed by the advocates of the Swing-Johnson bill as a victory second only to the one which they expect soon to crown their efforts in the enactment of the measure as a law. With the bill as an administration measure, the position of the Swing-Johnsonites is appreciably strengthened. Secretary Work's endorsement was unexpected, and should prove the more valuable on that account. Proponents of the bill, few of whom were sincerely hopeful of its passage in the present session of Congress, are now jubilantly confident that legislative action will soon be taken.

Conserving and Controlling Western Waters

1-Underlying Principles of Water Conservation*

By FRANK ADAMS

Professor of Irrigation Investigations and Practice, College of Agriculture, University of California.

IT CAN safely be said that the time has gone by when, in the minds of the people, conservation means *non-use*, or merely saving for the future. Certainly there can be no conservation of water except through use, and, just as certainly, the water supplies at hand during one generation can not be held over for a generation to follow.

Our water resources are fixed. We can not increase them, we can not decrease them; it is not fully proved that we can permanently jeopardize them. But we can fail to use them and we can waste them; we can permit uneconomic uses to grow up and rights that are adverse to the general good to become vested that will entail a heavy burden on future generations to correct.

Conservation of water, however, means more than merely its use without waste. Through lack of adequate legal control and of proper coordination of the different economic uses of water, we can fail to obtain the greatest advantage from them—the largest material wealth to the West and to the Nation, the largest sum of human satisfaction.

IN THE aggregate, Nature has been bountiful to the West in the matter of water supply. But she has left us gigantic tasks in physically controlling it and making it available when and where needed.

She has given us basins in which to store it, head through which to drop it for the generation of power, land on which to use it for the production of food and many of the raw materials of industry, and for the establishment of rural homes. But it has been left to us and to those who come after to devise and set up the institutions under which it can be controlled in the interest both of individuals and of society, and under which we shall organize to build and operate the works required to use it.

When we think of conservation and control of water, therefore, we comprehend not only its best use for our present needs, together with all of the engineering and agricultural and institutional factors that govern that use, but also its use and control in such fashion that the largest permanent values shall be created. We think of it as a public trust, to be administered under proper and adequate public authority, and in such manner as shall fully satisfy our present wants, and still carry over to the future a capacity to produce wealth unimpaired by our mistakes.

VIEWING conservation of water in the broad way just described we can set out a number of very definite steps that have been taken in furtherance of the principles the term signifies. It seems well to have these steps in mind before considering possible or desirable changes in, or additions to, present procedure.

Long before the term conservation was applied to the efficient and economical handling of our natural resources, it was recognized in the western states that however worthy some individual, private use of the public waters might be, such use might very easily be adverse to the interests of others, or to those of the public at large. Accordingly, under the leadership of Wyoming and Colorado, the western states early set about establishing such administrative control of the public waters as would encourage and safeguard use, stabilize rights, eliminate conflicts, reduce or prevent waste, and protect the interest of those to follow.

Of the sixteen western states all but one now have State administrative agencies that are effectively functioning, in a greater or less degree, along the lines indicated. Their authority is not adequate in all of the states—in three for instance, the State Engineer or similar official has no authority to refuse a permit to appropriate water if considered against the public interest—but generally speaking, accomplishments under the State water codes have been outstanding. Certainly their enactment was the first essential step in water conservation.

ONE of the first principles of water conservation set up in the statutes of the western states was that beneficial use should be the "basis, the measure and the limit" of the right to appropriate the public waters in the West.

In line with the theory of this doctrine, both the state administrative authorities and the courts have constantly sought to reduce or eliminate waste, and in numerous cases with very great success, even to the point of accomplishing "economic" rather than merely "beneficial" use. In ten of the sixteen states there is either specific statutory limitation on the amount of water an appropriator may take, or else there is authority for approving applications for less than

**This is the first of two articles which* MODERN IRRIGATION *will present from Professor Adams' address before the recent meeting of the Western Division of the Chamber of Commerce of the United States on the subject of "Conservation and Control of Water in the Western United States." The second installment, which will deal with the relationship between conservation and reclamation, will appear in an early issue.*—EDITOR.

the amount asked for, if there exists any substantial reason therefor. When authority is not adequate, and such is the case in several of the states, sensible administration has accomplished what under the law could not be compelled.

Under the ever-increasing demands of irrigation, and following almost complete utilization of the supplies available for direct diversion, development of storage is going forward rapidly in practically all of the western states.

Colorado was the leader in irrigation storage as far back as prior to the passage of the National Reclamation Act. The system of exchanges between stored water and direct flow worked out in that State to overcome topographic handicaps was recognized as an achievement at least twenty-five years ago. A sufficient number of irrigation reservoirs had likewise been built in several of the other states, particularly Utah, to establish their high utility, but conservation for irrigation on a large scale through storage received its first great impetus under the Reclamation Act. A second impetus was given by the necessities of hydro-electric generation. Henceforth these two uses will be so inseparably linked together as the basis of storage in the West that storage for one of them alone will be the exception.

THIS brings us to one of the most important of underlying western water conservation problems—preference rights to water and coordination of uses. Obviously, this problem has been precipitated by the rapidly increasing water demands of power development.

In nine of the sixteen western states domestic use is definitely given a preferred status, and presumably the same rule would hold in the others. One-half of these states give irrigation the second place and agricultural interests strongly hold out for this.

As between irrigation and domestic uses, jurisdiction has remained almost entirely with the states. The control of water *per se* is admittedly exclusively a function of the state. However, because of its control over navigable streams and of rights of way over Government lands and reservations, jurisdiction by the Federal Government enters in connection with coordination as between other uses and power.

While navigation plays some part in Federal control of western waters as against other conflicting uses, it is a decreasing obstacle because of the generally greater importance in the West of irrigation. Indirect Federal control of waters by virtue of Federal jurisdiction over rights of ways across Government lands and reservations, on the other hand, enters in a very vital way and involves, at least potentially, a direct conflict with state authority. Even recently some feeling has arisen between Federal and State interests in connection with the granting of certain irrigation rights adverse to power, and in these matters some believe the states should govern.

With Federal control in these matters now almost exclusively exercised under the Federal Water Power Act, however, and with an apparent recognition by the Federal Power Commission that where full utilization of resources can be accomplished under State laws, Federal jurisdiction should not interfere, there

FRANK ADAMS

Author of the accompanying article, and a member of the Investigations Group of the Advisory Board of MODERN IRRIGATION, *which is introduced on Page 13.*

seems to be no immediate issue of great importance as between these two sovereign authorities. In what has just been said there has been no reference to any suggested assertion by the Federal Govrnment that it holds ownership and control of the unappropriated waters of interstate streams, a subject on which at least one Western state has some very definite opinions.

ALTHOUGH the Federal Water Power Act is first of all a power measure—the jurisdiction of the Federal Power Commission is limited to projects designed to produce water power only—we can not overlook the fact that every effort was made when the Act was drawn to safeguard the water needs of irrigation.

The Act specifically holds that, in issuing permits and licenses, the Federal Power Commission shall give preference to irrigation districts, along with other municipalities and the states, provided their plans are equally well adapted to conserve and utilize in the public interest the available water resources. Furthermore, each approved power project must be the one that is best adapted to the comprehensive utilization of the available waters for other beneficial public uses as well as for power.

While the maintenance of their own prerogatives demands that the States assert what they conceive to be their own best interests in the matter of the proper coordination of uses of their waters, still it is indeed fortunate that we have in the Federal Water Power Act an instrument of control that conceives the problem broadly. There is no phase of the conservation of our water supplies more in need of being considered from the standpoint of the larger social values involved. The first step in maintaining these larger social values is a thorough knowledge of the facts for each of the streams on which action is to be taken by either State or Federal authority. Happily this has been recognized by both the state and the Federal agencies concerned, as evidenced by the thorough physical investigations that have been made of the Deschutes, the Columbia, the American, and the Colorado.

These and other considerations of coordination as between power and other uses have begun to establish certain principles that underly the problem. Among these the following can be enumerated:

(a) That the basic western industry is agriculture, and that this industry in increasing measure needs power and must rely very largely on the revenue from concurrent hydro-electric developments for making the important irrigation developments of the future financially feasible.

(b) That to a very essential degree successful agriculture is dependent on the other industries that hydro-electric power makes possible.

(c) That if the largest possible public interest is to be served, neither irrigation nor power can be given a permanently irrevocable preference over the other without a very clear showing of economic justification after a long-time view and balancing of the public benefits to accrue.

(d) And finally, if this can be considered a principle, that very nearly, and sometimes complete, economic equalizing of flow for irrigation can be accomplished by storage close to the point of irrigation use without jeopardizing the interest of power, the converse of this also being true.

Other principles than these will become clear as we carry our development farther and learn from our added experience. If, in the meantime, in dealing with this question of coordination, we can but adhere to the broad principles of conservation that have already been defined so fully, we can look forward to the future with a satisfactory feeling of safety.

Fortier, Adams and Etcheverry Constitute Important Group on Advisory Board

Nationally Known Figures in Investigation and Research Activities of Industry Serve as Counsellors to Magazine

IN THE introductory issues of this magazine, the majority of the members of its Board of Editorial Advisors, who serve with their suggestions and counsel in all matters affecting fundamental editorial policies, were introduced by word and picture to our readers. Several groups of this board, however, remain to be presented.

B. A. ETCHEVERRY

One of these is the group of three prominent California authorities representing "Investigations and Research", formed as a most important division of the Board of Advisors at the time of the magazine's establishment. This group is shortly to be enlarged considerably by the addition of representatives of investigations and research activities of the industry in Oregon, Arizona and Utah, and probably several other western states; but the charter members are California men who are, incidentally, widely known in all parts of the west and in irrigation circles throughout the nation.

Samuel Fortier

SAMUEL FORTIER, after completing his early engineering education, was engaged for years in the construction and operation of water works, irrigation systems and related hydraulic enterprises in Colorado and Utah. Later he became director and irrigation engineer of the Montana Experiment Station, but resigned this position in 1903 to take charge of the State and National co-operative irrigation investigations in California. After spending six years in this work in California and other Pacific Coast states, he was promoted to Chief of Irrigation Investigations of the U. S. Department of Agriculture and called to Washington, D. C.

Dr. Fortier remained at the head of this Division for 18 years and during that time nearly every phase of applied irrigation was investigated and reported upon by his small force of trained engineers and scientists. This work which was carried on for the most part in co-operation with Western states and state institutions, has had a notably beneficial effect in defining and establishing the water rights of farmers throughout the Western states, in elucidating the principles on which the science and art of irrigation depend, and in greatly improving irrigation practice.

Dr. Fortier is the author of over thirty state and government publications dealing with irrigation and water supplies and his book on the *Use of Water in Irrigation* not only is a practical guide for the irrigation farmer but is used as a text-book in nearly all of the western colleges and universities.

In 1912 he was delegated to assist the ministry of British Columbia in formulating what is perhaps the best irrigation code and administrative system on this continent.

Dr. Fortier is universally known and admired by the entire irrigation industry, and is often referred to affectionately, as the "grand old man of irrigation."

Frank Adams

FRANK ADAMS is Professor of Irrigation Investigations and Practice, College of Agriculture, University of California.

Mr. Adams entered irrigation work on June 1, 1900, and with the exception of 4½ years has been in it continuously since that date. From June 1, 1900 to June 30, 1925, with the exception of the 4½ years noted, he was connected, first as irrigation assistant, next as irrigation engineer, and later as irrigation manager with the Irrigation Investigations of the United States Department of Agriculture. During this period he made field studies at one time or another in nearly all of the western states, but more particularly in California, Utah, Colorado, Wyoming and Nebraska.

From February, 1910, to June 30, 1925, he was in charge of the co-operative irrigation investigations conducted in California by the Federal Department of Agriculture, the California State Department of Engineering, and the College of Agriculture, University of California, this co-operation at various times including also the State Conservation Commission of California and the California State Water Commission, now the Division of Water Rights. Since July 1, 1916, he has been professor of Irrigation Investigations and Practice, University of California, the latter now also including the title of Irrigation Economist in the University of California Agricultural Experiment Station.

SAMUEL FORTIER

While necessarily dealing with the agricultural and, to a lesser degree, with the engineering phases of irrigation, Mr. Adams has always been interested in the public and institutional phases of the subject. In 1912, he organized the Conservation Section in the Commonwealth Club of California and was its chairman until the section was subdivided into a

(*Continued on Page 35*)

Arthur P. Davis Describes Plan to Bring New Water Supply to East Bay Cities

Tells Engineering Features of Mokelumne River Project, Key Unit in East Bay Municipal Utility District's Program

By ARTHUR P. DAVIS

Former Director U. S. Reclamation Service; Chief Engineer and General Manager, East Bay Municipal Utility District.

ANYTHING written by Arthur P. Davis, internationally known authority on hydraulic development, is assured of an interested reading in the irrigation, water works and allied industries. When he describes, as he does in this article, one of the most significant developments now going forward in municipal water development in the West, the result is of two-fold value. The East Bay Municipal Utility District, serving nine municipalities with an aggregate population of almost half a million people, has had to face unusual problems, and in preparing to meet them has planned on a vast scale to bring water from high in the Sierra Nevada Mountains. The first unit of the district's program, as described here in detail, involves a cost estimated to require a bond issue of $39,000,000, and will deliver about 60,000,000 gallons per day to the district.

THE East Bay Municipal Utility District was organized May 22, 1923, comprising the cities of Oakland, Berkeley, Alameda, Piedmont, Richmond, San Leandro, Albany, Emeryville and El Cerrito. These cities are all contiguous and have a combined estimated population of about 450,000 people. They are all served with water by the system of the East Bay Water Company and the District was formed for the purpose of acquiring this system and for bringing in an additional water supply from a suitable distant source.

The District

The District organization was the result of a great many years' agitation, study and effort to bring to the East Bay region an adequate water supply. The District is now largely built up and is virtually one city. It contains nine municipalities which were formerly actually and, at present, legally are different cities. They were formerly served by not less than 12 different corporations. By various processes of consolidation, purchase, re-organization and so on, they have been fully merged into the present East Bay Water Company.

Water supply was originally drawn mainly from wells and a few springs. These were supplemented by the construction, in 1874, of Lake Chabot on Lower San Leandro Creek. Since that date, this reservoir has been an important water source of the system but a large portion of the present water supply is still obtained from wells. For more than twenty years it has been recognized that the system was inadequate, and the condition has been met from time to time by small additions, either of wells or of reservoirs, but never has any assured supply been adequate for any considerable growth or for unusual drouth. Serious shortage occurred in 1918, and one still more serious has been imminent for the past two years.

WHEN the spring of 1924 arrived without the usual winter rainfall, the East Bay Water Company, appreciating that its reservoirs were very low and that they could not be replenished for many months, increased its pumping facilities to a capacity of about 21 M. G. D. or more than two-thirds of the amount being delivered. The balance was drawn mainly from reservoirs on San Pablo and San Leandro Creeks.

The heavy draft on the wells, together with the depletion of the supply caused by the long, dry period has lowered the water plane of the pumping district to an alarming extent. In the Alvarado region, from which most of the pumped water comes, careful observations have been taken upon five wells which are typical of the position of the water plane. Prior to 1918, none of these wells had ever shown a stage below sea level. In that year, one of them went slightly below but soon returned above and all of them remained above sea level until 1920 when four out of the five were drawn below sea level dur-

Lancha Plana Damsite, (looking down stream). It is here that water will be impounded by a high dam, to be carried across the San Joaquin Valley through a great aqueduct, and delivered to nine East Bay municipalities, with a population of almost half a million.

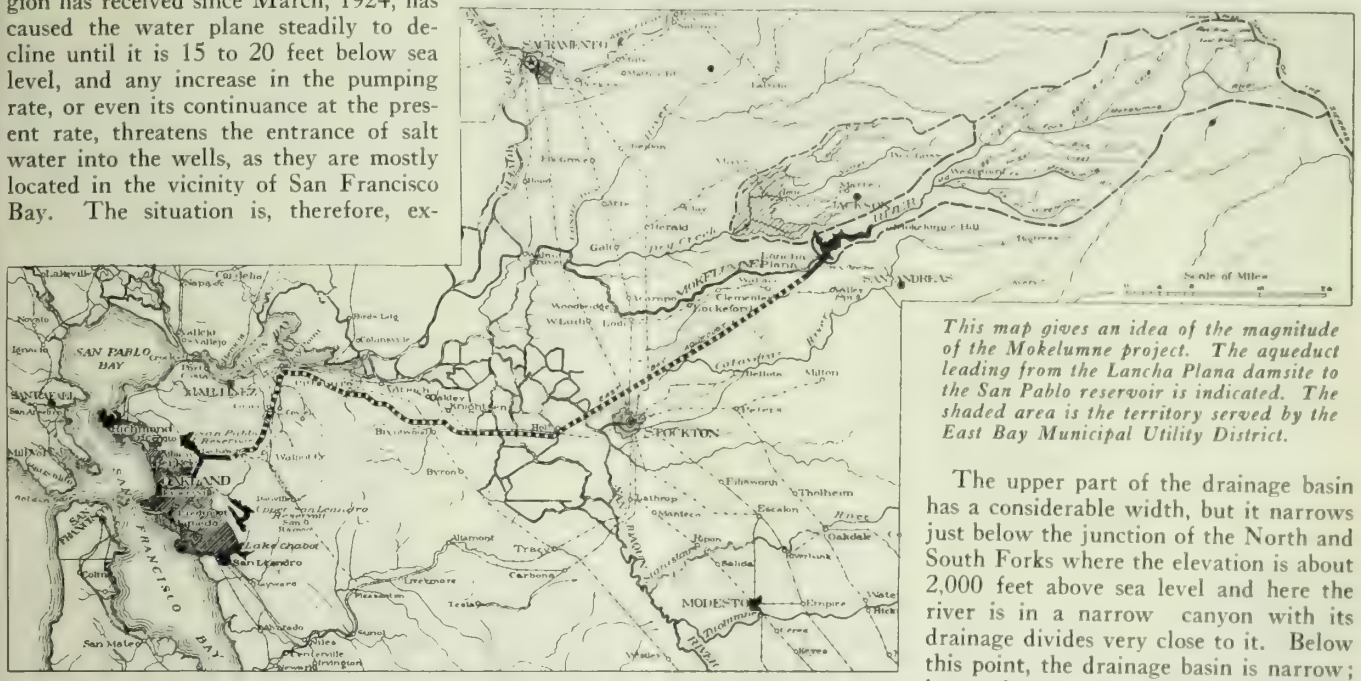
ing the dry season to the extent of about 7 feet. The water levels in these wells returned to a stage above sea level in the spring of 1921. The same thing occurred in 1922 but in 1923 the water level in four of these wells declined below sea level, and the winter of 1924 was so dry that the water level in all of them continued to decline under the gradually increased pumping demands.

The vigorous pumping that this region has received since March, 1924, has caused the water plane steadily to decline until it is 15 to 20 feet below sea level, and any increase in the pumping rate, or even its continuance at the present rate, threatens the entrance of salt water into the wells, as they are mostly located in the vicinity of San Francisco Bay. The situation is, therefore, extremely critical and, unless the present winter produces more rainfall than last winter, there wil be a severe and disastrous shortage of water in the East Bay District.

THE FIRST tax levy of the new district became available the first day of July, 1924, and a large force of engineers and surveyors were put to work immediately upon the selection and survey of the most promising of the water sources. A board of consulting engineers, consisting of General Geo. W. Goethals, William Mulholland and Arthur P. Davis, in September, 1924, after a comparison of the surveys and estimates of the various sources investigated, decided that the most promising and economical source, satisfactory for the purpose, was the use of the Mokelumne River with a high dam near Lancha Plana, where water would be stored and piped to the District through an aqueduct across the San Joaquin Valey.

This board recommended a bond issue of $39,000,000 as being adequate to bring in, without peradventure of failure, the first unit of this project to deliver about 60,000,000 gallons per day within the District, and to provide reservoir and tunnel capacity for a larger amount to be utilized by building additional pipe lines across the San Joaquin Valley, as the needs demand them.

Plans and specifications for the first unit were issued and bids invited in June, 1925, to be opened September 4 of the same year. These bids were remarkably favorable, showing keen competition between steel manufacturers and others for the work. The prices under which the contracts were let indicate that the work will be accomplished from 20 to 25 per cent under the liberal estimates that were made to cover all contingencies.



This map gives an idea of the magnitude of the Mokelumne project. The aqueduct leading from the Lancha Plana damsite to the San Pablo reservoir is indicated. The shaded area is the territory served by the East Bay Municipal Utility District.

The Project

Rising at the crest of the Sierra Nevada range of mountains, the Mokelumne River flows in a general direction a little south of west, and empties into the San Joaquin River near Central Landing. The drainage area of the river at Clements, where it emerges from the foothills, is 632 square miles. At this point, a station is maintained by the United States Geological Survey for measuring its discharge.

The river has three principal branches known as the North Fork, the Middle Fork and the South Fork. The areas drained by these tributaries are, respectively, 370 square miles, 70 square miles and 76 square miles. The North Fork is fed by the tributaries Antelope Creek, Mill Creek, Tiger Creek, Panther Creek, East Panther Creek, Bear Creek, Cold Creek, Summit Creek, Deer Creek, Blue Creek and Moore Creek.

As is evidenced by its greater drainage area, the North Fork is the main stream. It has more than two-thirds of the drainage area and more than three-fourths of the discharge. It is the only fork that heads at the summit of the Sierras where the precipitation is greatest.

The Middle Fork joins the South Fork before it reaches the main river. The drainage area above the junction of the North Fork and the South Fork is 523 square miles.

The upper part of the drainage basin has a considerable width, but it narrows just below the junction of the North and South Forks where the elevation is about 2,000 feet above sea level and here the river is in a narrow canyon with its drainage divides very close to it. Below this point, the drainage basin is narrow; hence the water supply comes from the higher mountains, mostly above 2,000 feet in elevation.

Only a small part of the water supply has been diverted but this includes all of the low water flow of normal seasons.

THE Pacific Gas and Electric Company has developed a power system in the basin of North Fork, the power house being located a few miles northeast of Mokelumne Hill at a point called Electra. This power system includes five small storage reservoirs, at Twin Lakes, Upper Blue Lake, Lower Blue Lake, Meadow Lake and Bear River. These reservoirs aggregate about 26,000 acre-feet in storage capacity. Their waters are released into the natural stream channels and flow to the headworks of two ditches on the North Fork, one having a capacity of 135 second-feet and the other 75 second-feet. These two ditches parallel each other along the north side of the river and each has a small forebay reservoir and penstock leading to the power house on the main river. The available head from the higher reservoir is 1466 feet and that from the lower, 1266 feet. The power house has an installed generator capacity of 20,000 K. V. A., and its water wheels have a ca-

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A TYPICAL GRAPE-FRUIT GROVE IN THE LOWER RIO GRANDE VALLEY. THERE ARE 3,000,000 CITRUS TREES NOW GROWING IN THIS DISTRICT.

How a Rio Grande District is Reconstructing Its System

By W. L. ROCKWELL

Supervising Engineer, Hidalgo County (Texas) Water Improvement District No. 4

A PLAN of reconstruction which has been undertaken by the Hidalgo County Water Improvement District No. 4 in the lower Rio Grande Valley, Texas, is of more than local significance. It is the first step toward the union, into one system, of all the second bench irrigated interests of the valley (comprising more than 150,000 acres), which will mean conservation of water, cheaper rates and better service for all this territory. The reconstructed system, which will be completed and placed in service in May, 1926, is therefore one of the most interesting developments taking place in this important irrigated area.

The plan involves a change in the point of diversion of the district's water supply, and the rehabilitation of the entire distribution system. The benefits to be accomplished by it are manifold. It will provide a permanent and safe pumping site; the canal system will be placed entirely above overflow; the district will have but a single pumping plant to operate and maintain; $150,000 will be saved in installation cost; the pumping head will be reduced twenty-five per cent, and the cost of operation and maintenance thirty per cent.

A GENERAL understanding of some of the characteristics of the whole valley is essential to an appreciation of the reconstruction plan of Water Improvement District No. 4. The Lower Rio Grande Valley includes the delta of the lower river extending in an easterly direction from the town of Mission, Texas, to the Gulf of Mexico, a distance of about 80 miles. The valley lies in the form of an isosceles triangle with the apex near Mission, and the base the Gulf coast. The Rio Grande in its meanderings nearly bisects the triangle, the United States and Mexico sharing about equally in the area of agricultural land of the delta, aggregating, perhaps, 1,000,000 acres.

The banks of the river, like those of all delta streams, are higher than the ground surface to the north or south, the slope being down the river and away from the stream at a rate of about one foot per mile, producing a resultant toward the northeast of about 1½ foot per mile. This slope continues north for five to ten miles, to an abrupt rise of 20 to 30 feet, from which the slope continues eastward and finally merges into the Gulf coastal plain.

The topography of the first bench is quite level; that of the second bench slightly rolling, allowing sufficient slope to give good surface drainage. The Arroyo Colorado and its tributaries are the remnants of an old river channel and form the basis and outlet for an excellent drainage system for the first bench lands of the alley.

The climate of the valley is semi-tropical. The temperature is such that crops may be produced continuously throughout the entire year. A light frost occurs nearly every winter, but seldom is there one that is destructive to plant growth, even of tender vegetables. The annual precipitation in the lower valley varies from nearly 30 inches on the coast to 20 inches at Mission. Unfortunately the rainfall is very uncertain both in time, interval and quantity. There is no certainty in either time or volume in any given year; hence all agriculture is dependent on irrigation. The valley has as fertile a soil as can be found in this or any other country. This is verified by the wide variety and prolific yield of its products.

The source of the water supply of the valley is the Rio Grande. There are now under irrigation on the American side of the river upwards of 250,000 acres. At least 500,000 acres have acquired a permanent right to the use of water by reason of continuous development and beneficial use. A large quantity of the diverted supply is undoubtedly wasted, but this waste is being gradually reduced by the installation of meters, by the lining of canals, and by better methods of land preparation and water distribution.

EARLY settlers in this district turned their attention to the growing of vegetables for the winter and early spring markets. In some instances large returns were received, but, on account of poor transportation and marketing facilities, the larger number were unsuccessful.

Here and there a farmer planted a few orange, lemon and grape-fruit trees. In two years these began bearing an excellent quality of fruit which brought large returns. This created an interest in citrus production and the acreage increased, until at present the citrus expert of the U. S. Department of Agriculture estimates that there are 3,000,000 citrus trees growing in the valley.

Vegetables of excellent quality are being grown to supply the winter and early spring markets of the north and east, and transportation facilities are rapidly improving. Dairying is very profitable.

The climate and every other condition are conducive to cheap feeding of the dairy cow and to a large milk and butter-fat return. Long-staple upland cottons produce large yields, and under intensive work should produce 750 pounds of lint per acre.

THERE are thirteen independent irrigation projects operating in the valley, in addition to a number of small plants. Eleven of the projects are Water Improvement Districts, organized under state provision, and two are private corporations. They include 450,000 acres, a corporate investment of more than $20,000,000 and a farm value of $135,000,000. A very conservative valuation of the capital represented in these projects is $155,000,000, which does not include values in towns and other properties.

Hidalgo County Water Improvement District No. 4 is situated in the western portion of the delta. Its population is about 2,000. The town of Edinburg is situated within the district's boundaries, but is not a part of the district. The town of McAllen, with 4,000 population, is near the south end of the district, and Mission, with 5,000 population, is only three miles west.

The gross acreage of the district is about 40,000 acres, which, with roads, canal right-of-way, building sites, high and low lands deducted, leaves approximately 34,000 acres of irrigable, cultivable land. The project has no land on the first bench, hence no overflowed lands. The surface slopes toward the north and east at a rate of from one to five feet, permitting of fair gradients and reasonably cheap canal construction. The fields have fair slopes for the distribution of water for the disposal of excessive rainfall.

The area receiving water may be increased as much as 10,000 acres by supplying land which lies along the Penitas main, and which has asked for water by special contract.

IN the reconstruction undertaken by District No. 4, the point of diversion was moved up the river a distance of ten miles. The re-location is situated upon the north bank of the Rio Grande, about eight miles west of Mission, in the Mexican pueblo Penitas, and is upon a bank of heavy residual clay, the bottom of which has not been reached. The channel of the river is about 1,500 feet distant and is slowly moving toward the plant side. As far back as records have been kept, 1853, the channel has remained very close to its present location, old Mexican residents declaring that eighty years ago it flowed alongside the plant side.

East main headgates, Hidalgo County Water Improvement District Number Four. The district is now moving its diversion point up the river a distance of ten miles.

Briefly, the plans for the new work on the reconstruction of the system call for the excavation of a channel, nearly fifteen hundred feet long, extending from the river to the plant site, the bottom of this channel to be six feet below extreme low water, to be thirty feet wide upon the bottom, the side slopes to be two horizontal to one vertical, the levees to be carried well above extreme high water, and to have a ten-foot crown. A small canal will be placed along the top of these levees in which water (fed from the surge tank) will be run. Bermuda grass will be planted on the top and slopes of all levees.

The power house and intake bays will be monolithic reinforced concrete, the floor of the bays six feet below extreme low water. The building will be 48 feet by 101½ feet inside measurement, the walls reinforced by counterforts spaced eight feet apart and extending from floor to top of wall. The roof will be of corrugated iron, supported by steel trusses. The floor will be monolithic, six feet thick, and heavily reinforced.

THERE will be installed six pumping units of the same size, all parts interchangeable. The engines will be three hundred and sixty horse power, full-Diesel, and direct-connected to 30-inch horizontal, double suction, centrifugal pumps, of 30,000 gallons per minute capacity. The suction and discharge pipe will be 48 inches in diameter, the suction intake bell mouth, increasing to a diameter of five feet. The pumping units are to be set staggered in three lines, the suction and discharge pipe passing under and between the pump and engine of the units either side, permitting of a very compact installation. Lighting, priming, air starting, cooling, and fuel and lubricating oil cleaning units will be provided, and a five-ton crane will be installed.

Each pump will discharge through a 48-inch pipe to a 48-32 Venturi meter with recording device for second foot discharge and continuous record. From the meters the water passes through a surge tank to seven-foot square twin tubes of re-inforced concrete, 1154 feet

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Placing the steel for the tubes under the Shary Canal—one of the interesting tasks included in the reconstruction plans of Water Improvement District No. 4 described in the accompanying article by W. L. Rockwell. The district is taking the lead in a program in which all "second-bench" lands are expected eventually to join.

Making *Irrigation Credit* What it *Should* be

Some Considerations of District Finance That Will Conserve This Invaluable Asset

By B. J. SEGER

Secretary-Treasurer of the North Platte Valley Water Users Association and the Farmers Irrigation District, Scottsbluff, Nebraska.

LARGE IRRIGATION projects will, in times of emergency, such as a serious break in the canal, need to borrow large sums of money; greater than the local banks can loan, as a rule, because of the length of time the loan must run before being paid.

A trust company or some other large financial institution is the usual agency for large loans. At such times it is highly important that an irrigation project have its credit well established. A record of prompt payment of taxes by the landowners and the prompt payment of the obligations of the district will aid materially in establishing this necessary credit.

It is important that the officials of an irrigation district maintain the collection of irrigation taxes as near one hundred per cent as possible so that the district may be on a cash basis. If on a cash basis, there would be no warrants to issue and no interest or discounts to pay as far as operation and maintenance of the system are concerned—a tremendous saving over a period of years. Under large projects where the cost of building the project has been comparatively high, resulting in a rather heavy tax, it is found advantageous to provide that the landowner may pay his irrigation taxes in two installments. The laws of a number of the western states now provide that irrigation taxes, as well as other taxes, may be paid in this manner. In some states a discount of five per cent is allowed if taxes are paid when due. The discount features would encourage payment of taxes when due, and two payment dates would enable men of small means to pay, who might find it impossible to pay the entire tax at one time.

OFFICIALS of many irrigation projects make the mistake of not taking more interest in the individual farmer on the project. As mentioned in the first article in this series, there are many ways in which a district board can assist the individual farmer in addition to giving him good water service. Pests may threaten to ruin his crop. Prompt action on the part of the board in securing the necessary material and equipment to combat the pests may be the means of saving his crop. He may be short of labor at a critical time. The board can often assist materially in securing the needed help. Anything that the officers of a project can do to assist the farmer in time of need will mean more than the saving of crops. It will mean the friendship and good will of the farmers on the project. With successful, satisfied farmers and with proper management, the project will be a success and its securities will be rated first class.

If officers of an irrigation system give some consideration to the purchaser of the securities they may have to sell, such as making provision for the payment of interest on warrants which run longer than a year, also providing that coupons on bonds shall bear the same rate of interest as the bond if the interest is not paid when due, their securities will sell more readily and at a good price. Sometimes a type of bond is issued which is not salable. For instance, the rate of interest may not be in line with the condition of the bond market at the time the securities are offered for sale. Securities which, on account of type, are difficult to sell, must be sold at a greater discount. It is a good plan when considering the issuing of securities to consult several bond houses, to ascertain the condition of the bond market, and the type of bond which would sell most readily; also to follow carefully the instructions of a good bond attorney in the preparation of the bond history, etc.

AGAIN, if district officials would realize the importance of establishing a "seasoned bond"—a bond on which default has not been made in the payment of its interest coupons or principal for at least four years, they would never allow a default to be made. A district having a "seasoned bond" will have no difficulty in refunding if advantageous to do so, or in floating additional bonds or other evidences of indebtedness. Care in this matter would be of material help in maintaining the credit of the district.

As a rule, a serial bond is more desirable for both the district and the buyer. A serial bond issue which provides for the retirement of a definite number of bonds each year is the best for the project for the reason that it is reasonably certain that the debt will be paid during the life of the bond issue, and, further, that there will be a material saving in interest over the semi-serial type of bond. Usually a bond house prefers a serial bond for the reason that some of their customers desire short-time maturities, others, long-time maturities. This type of bond is better for the additional reason that as early maturities are paid the security back of the remaining unpaid bonds grows better each year.

An important factor in bringing irrigation securities to a higher plane, so that they will have the same rating and standing as any high-grade securties, is that laws be enacted whereby the state will provide for the careful inspection of every proposed irrigation project within the state. The state engineer should make report as to its feasibility, water supply and his estimate of the cost of building the project. Many irrigation projects have failed because a careful estimate of the cost was not made in the beginning.

In addition to the report by the state engineer, there also should be a report made by the director of the State Geological Survey. He should make exhaustive tests of the soil, as to its productivity. He should also make thorough examination as to the texture of the soil, so that he will be in position to report as to the probability of seepage. The state's attorney-general should then pass on the legal phases. It would also be well to consult an expert on irrigation finance and secure a report as to the best method of financing the proposed project. Finally, the land should be classified into at least four classes and classification maps prepared.

IN SOME states, a commission is formed consisting of the above named officers for the purpose of passing on all proposed irrigation projects. In states where such a commission has been in operation for a number of years the plan has been found quite satisfactory. Projects organized with the approval of such commissions have had no difficulty in selling their securities at a good price.

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This article by Mr. Seger is the second and concluding installment of a series of two which he has written for MODERN IRRIGATION, *on the general subject of "Credit for Irrigation Projects — How to Establish and Maintain It." The first article appeared in the December issue.*—EDITOR.

When Progress Came to the Peaceful *Valley* of *Content*

How a Small Dam, Skilfully Planned, Brought Water for Irrigation and Domestic Use to the Willits Valley

By CRISTEL HASTINGS

FOR UNNUMBERED years the peaceful Willits Valley lay dreaming in the sun, a typical valley of content, whose good people appreciated above all else the serene peace of the hazy, oak-clad hills sloping down the skylines all about, and who absorbed of this peace until life had become a most tranquil thing, indeed.

They dreamed, too—these people in the Mendocino valley lands — of the great things that Progress eventually would bring them over the Redwood Highway, but to many of the contented ones there seemed no especial need for hurry. Irrigation was looked upon as an Herculean undertaking—quite beyond any immediate need. To the isolated farmer "expense" can assume the proportions of a most terrifying bugaboo, especially if it concerns a project of which he may have little or no knowledge.

True, the valley lands all about were intensely fertile, but much of the rich alluvial soil lay barren of crops, more or less, as irrigation was but a fitful thing that depended almost solely on the fickle generosity of Pluvius! Although life was a bit primitive in some sections —pump handles still had to be put into vigorous action morning and night, and lamp chimneys had to be polished daily —life on the valley farms largely followed the beaten trail of yesterday.

IT WAS inevitable, however, in spite of the charm of existence among these peaceful hills, that this rich region (one of the richest in California) should be discovered by engineers, who instantly appreciated the natural site for a lake that was to be; and into whose great basin the waters of James Creek now flow, where they are impounded for domestic and irrigation purposes. For engineers did come, in 1923, and their vision from a hill-top pictured a lake of flowing silver that could and would be converted into golden use for the good people of the valley and town only five miles to the northeast. The names of Edward Morris andC. E. Grunsky of the American Society of Civil Engineers, are marked indelibly into the newer chapters of Mendocino County's progressive history, and the name of the former has been given to the dam which he envisioned.

Recognizing the oboing, stump-strewn, manzanita-clad hollow among the hills as an ideal water-storage basin, and discovering, too, the fact that nature had already provided a narrow outlet at the lower end of this gently sloping depression flanked on both sides by towering walls of solid rock, the engineers found their problem relatively simple. How this natural and most ideal site, five miles southeast of an important and thriving community on the famous Redwood Highway, ever came to be overlooked all those idle years remains a mystery; but overlooked it was, until the splendid project that now insures the Willits Valley an adequate water and power supply became something more than a dream.

NOT ONLY was it possible to build a dam of unique construction at the mouth of this abrupt gorge, but the natural advantages of the lake site made for an economic saving in the building of the Morris Dam totaling many thousands of dollars. This proved particularly fortunate in that the introduction of any innovation, especially if it be a utility project, usually meets its most strenuous opposition because of the expense involved.

The presence of the narrow and very abrupt gorge at the lower end of the lake site saved many dollars. This gorge proved to be the solitary outlet, making it entirely practical, because of the walls of solid rock on both sides of this narrow cleft, to build a thin arch type of dam, of which there are but few in the West. Measuring 107 feet from end to end, this slender crescent of reinforced concrete and steel bars, with its 90-foot radius, stands 40 feet high—with a base width of 8½ feet, the latter gradually tapering to a 3-foot thickness at the top.

The Morris Dam, Willits, California, an interesting example of the thin-arch type of structure.

The Morris Dam was barely completed when it was called upon suddenly to prove its tensile strength of 350 pounds to each square inch of wall surface. While the concrete was still "green" and but a few days more than two weeks old, the dam was subjected to the ordeal of weathering a sudden storm that made of James Creek a swollen, vicious thing that filled the new dam to overflowing. But its builders had builded well, and when the peak was past, dawn found the gray wall still upright.

The wall is reinforced at 12-inch in-

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The EDITORIAL

MODERN Irrigation

An Organized Voice for the Forces of Agriculture and Industry Which are Primarily Dependent upon Irrigation.

Published Once a Month

AT LOS ANGELES, CALIFORNIA, BY THE

PETROLEUM WORLD PUBLISHING CO. *Editorial and Executive Offices, 626 South Spring Street, Telephone Broadway 3262.* Branches: SAN FRANCISCO—447 SUTTER STREET, *Telephone Garfield 2772;* H. E. TAYLOR, *Manager.* CHICAGO—1163 MONADNOCK BLDG., *Telephone Wabash 8855;* JOSEPH E. O'CONNOR, *Manager.* NEW YORK—503 FIFTH AVENUE, ROOM 308, *Telephone Vanderbilt 8753;* WERNER HAUPTLI, *Manager.*

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By Annual Subscription in the United States and possessions, $2.00; Foreign, $2.50; Single copies on sale in the irrigation country, 20 cents. In ordering change of address, give both the old and the new address. Allow ten days for re-entries on the subscription list. Advertising rates and circulation data upon request. Checks should be made payable to Petroleum World Publishing Co.

VOL. II JANUARY, 1926 No. 1

Introducing Volume Two

WITH the beginning of 1926, MODERN IRRIGATION opens its second volume. The magazine was established in July, 1925, and has published six issues preceding the current number. As was expected, the first six months have been largely a matter of getting the journal's feet on solid ground. With the present issue, the magazine enters upon a new era in its career.

The service which any publication can render, presupposing that it is sincerely actuated by motives of service, depends primarily on the support accorded it by advertisers. So far, MODERN IRRIGATION has been most generously supported, but because it was established in the middle of the year, when many advertising appropriations were fully allotted or exhausted, it has, perhaps, not had quite as broadly representative a content in its advertising pages as will be brought about by the new year. In this issue, several new accounts are in evidence, and many others will be added during the next few months. Each of these enables the magazine to give more valuable service to its readers, and, accordingly, increases its worth to its advertising patrons. Nineteen-twenty-six should be a year of splendid growth; in fact, developments thus early justify the assertion that Volume II will make MODERN IRRIGATION a very materially larger and better magazine.

The Mexican Policy

THE WISDOM of a law depends not so much on what is written in the statute book as on the spirit of its enforcement and administration. For that reason it is still much too early to judge of the probable effects of the irrigation law passed late in December by the Mexican Congress. This law declares irrigation a public utility and creates a federal commission with the power to take over undeveloped lands with or without the approval of the owners in fact, and to develop their potential irrigation resources for the government, returning a part of the irrigated lands to the owners as compensation.

The law is directed against an acknowledged evil—the prevalent practice, on the part of large landowners, of holding huge acreages in an undeveloped state. It includes a wise provision, also, in that it gives the owner of the land the opportunity to undertake irrigation development without government interference if he will do so. Under the most fortunate circumstances, therefore, it may be productive of much good. The large land-owners, under the threat of government confiscation, may be moved to an activity which will be socially salutary for the Mexican nation.

On the other hand, there are many forceful examples of government control of irrigation development that should give pause to any such wholesale adoption of a policy of government ownership and operation (which it will amount to) in a country no further developed in the science of government than is Mexico. The United States' experience with reclamation under political control has not been sufficiently inspiring to justify optimistic hopes for the success of the new Mexican policy. And yet the United States is certainly more stable, politically and economically, than is the Land of Manana.

But there is opportunity in Mexico for practically unlimited agricultural expansion, if efficient methods of irrigation are brought to the assistance of the farming class, and the recent action of the Mexican Congress would indicate, at least, that these opportunities are to have recognition. President Calles has already made plans for a development program to involve the expenditure of ten million dollars a year for each remaining year of his term of office. If this money is economically and wisely spent, it may mean the introduction of a great new day for the southern republic.

An Interesting Situation

FACED with unique problems of irrigation, and somewhat separated from the more intensively irrigated areas of the far west, is an important province of the irrigation empire, located in the lower Rio Grande Valley. Here are approximately a million acres of ir-

POINT *Of* VIEW

rigable land, about 250,000 of which, situated on the American side of the river, an international boundary line, are under irrigation. In this issue an authority in the development of this section describes the reconstruction plans of a district which is taking the lead in improving the facilities for diverting and distributing the water supply of the whole section.

The lower Rio Grande has pressing problems in addition to the fiscal and engineering difficulties which it faces. The water supply of the Rio Grande has been practically fully appropriated. In order to extend irrigation, storage works are required. And in order to plan storage works on the river, the consent and approval of Mexico are necessary. Mexico, through its superior tactical location with respect to the source and course of the river, holds the whip-hand in negotiating for such developments, and is entirely cognizant of the fact. The situation, therefore, is one which will repay study by the entire irrigation country, for Mexico's interests and those of the United States are in conflict in more regions than one, and any factors which affect the situation, whether on the Pacific or on the Gulf Coast, will be important in the final determination of rights. Articles discussing various features of this interesting situation will have place from time to time in these columns.

"The Open Forum"

UNDER a department heading newly introduced in this issue, entitled "The Open Forum", C. W. Brockman, a director of the Imperial Irrigation District, expresses his version of the views of the minority element in the Imperial Valley, which opposes the policies of the four majority directors. It is the purpose of this magazine to give expression to both sides of controversial questions, in the interest of fairness and of informing the public as to the issues involved, and Mr. Brockman's statement is published at the request of himself and his friends in reply to an article in a recent issue by Earl C. Pound, president of the district, in which Mr. Pound gave an interesting interpretation of the re-organization policies which were recently undertaken there.

In the "Open Forum," from time to time, the magazine will present the variant views of informed men who are interested in one side or another of significant questions in the field of water development. The department will be conducted in conformity with the pronouncement of that great American who was always ready to recognize that his bitterest oponents were entitled to hold and to support their views, and whose principle for dealing with them was "malice toward none and charity toward all."

From the standpoint of interesting reading, this department should soon come to be the most lively and appealing of any in the entire magazine, but it is introduced with the hope that it may accomplish more than that—that it may, in some cases at least, point the way to the harmonizing of the conflicting views presented, in the interests of concord and progress for the industry as a whole. For this reason the editors have asked that contributors should avoid personalities, should make their criticisms constructive, should base their statements not on opinion but on fact, and should observe a temperate and courteous attitude toward those who may not be in agreement with their ideas.

Defining a District's Powers

LEGAL POWERS of an irrigation district, as constituted under the laws of California, do not include the right to expend the district's funds for the support of, or opposition to, pending legislation, it has been held by a court decision. The decision came as the result of an action directed at restraining the directors of the Imperial Irrigation District, in California, from spending more money in the interest of the Swing-Johnson bill. As a consequence of the opinion rendered by the court, the directors have gone formally on record ordering that no further moneys shall be spent for such purposes.

The decision is important, not so much for its effect on the destiny of the particular legislative proposal involved in this case, as for its general application in other districts and with regard to other measures in which the officials of an irrigation district may feel justified in spending the public money in order to influence the outcome.

Its effect on the fate of the Swing-Johnson bill will probably be negligible. The directors are admittedly strongly in favor of the plan of Colorado River development outlined in this measure, and they have spent considerable money, in one way or another, to further it before Congress. All of this, they point out, has been spent only on the advice of their attorneys, and not only of their present legal advisor, but of every attorney which the district has employed, all of whom have agreed in the opinion that such expenditures were strictly within the legal powers of the district. Now they have put a stop to these expenditures, but an un-official organization of the Imperial Valley, favoring the Swing-Johnson bill, has undertaken to assume the responsibility for continuing the representation of the bill's advocates at Washington.

This, it would seem, is as it should be. Regardless of the merits of the Swing-Johnson bill or any other proposed method of developing the Colorado River, it is indisputably a fact that there is a considerable element in the Imperial Valley that does not want to see the district's funds spent in lobbying in favor of the measure. Those who favor it are entitled to spend their money in its support, but those who do not should not be compelled to contribute for the purpose. The decision of the court which holds such appropriations to be outside the legal powers of an irrigation district is important in defining the functions which the officials of an irrigation district may properly exercise.

THE OPEN FORUM

INTRODUCING a new department in which our readers may present their views on significant questions of general interest to the whole field of water development. Contributors are requested to avoid personalities, to make criticisms constructive and temperate, and to base all statements on fact rather than opinion. The editors will reserve the right to abridge or reject contributions at their discretion.

A DISSENTING INTERPRETATION

By C. W. BROCKMAN

Minority Director, Imperial Irrigation District

THE IMPERIAL Irrigation District is located in the extreme southern part of California and comprises 603,000 acres of land, of which approximately 515,000 acres are irrigable.

The source of its water supply is the Colorado River and the water is conveyed through 137 miles of canal in Mexico, thence to the United States. The daily diversion varies from 2,000 second feet to 7,000 second feet and averages about 3,500,000 acre feet per annum.

The Imperial Irrigation District delivers water from its canals in Mexico to approximately 200,000 acres of Mexican land, for which it receives a revenue of from 500,000 to 600,000 dollars per annum.

DUTIES of the District may be defined as follows:

1st—To construct and maintain seventy-one miles of protective levees, of which thirty-two miles are along the Colorado River. Fifty miles of levee are protected with standard gauge railway and are heavily riveted with rock on the water side. These levees are located in Mexico and protect the Valley from the encroachment of the waters of the Colorado River.

2nd—To maintain diversion and headworks to assure an ample supply of water in the canals at all times.

3rd—To maintain one hundred thirty-seven miles of canals in Mexico, delivering water to users in Mexico and to various points in the United States.

4th—To operate and maintain one thousand six hundred sixty-nine miles of canals and laterals in the United States. with over four thousand six hundred delivery gates or turn-outs.

5th—To distribute water to five thousand users on less than twenty-four hours notice, any day of the year.

6th—To maintain five hundred six miles of surface waste ditches for removing waste water from a considerable portion of the District lands.

7th—To locate and construct drainage outlets for the entire District.

8th—To maintain one hundred six miles of drainage outlets and control the Alamo and New River channels.

EVERYONE concerned with irrigation is naturally interested in the affairs of the Imperial Irrigation District, in Southern California, probably the largest organization of its kind in the world. For that reason, when recent developments indicated that a wholesale re-organization of the big district was in progress, MODERN IRRIGATION *asked President Earl C. Pound for a statement. His story, headed "What the Board of Directors of the Imperial Irrigation District is Trying to Do," appeared in the September issue. Mr. C. W. Brockman, minority member of the Board, now comes forward to declare that Mr. Pound's story was only one side of a very two-sided question, and requests that, as a representative of the opposition, he be given opportunity to present his version of the somewhat involved situation.* MODERN IRRIGATION *is not, very obviously, the proper place for unlimited debate upon controversial questions; neither does it feel that it necessarily "started something" when it printed a straightforward explanation of an irrigation district's plans in the form of an official statement from its president; but since Mr. Brockman feels that he should have his day in court, his communication is given space. Having heard from both the affirmative and negative on this subject,* MODERN IRRIGATION *considers the matter closed and has no desire to continue the discussion.*—EDITOR.

TO PERFORM these duties, five directors, a treasurer and an assessor and collector are elected. All duly registered voters, living within the boundaries of the District, either on farms or in towns or cities, have the right to vote at all district elections.

The inventory value of the District System is approximately twenty-five million dollars. The average number of employees is twelve hundred and the annual expenditure for all purposes is between $3,000,000 and $3,500,000.

With a project of this magnitude, those who are interested in seeing the Imperial Irrigation District maintained as a successful, business like enterprise, are anxious that it should have the best trained and most experienced direction. They therefore, believe that the majority of the Board of Directors have acted very unwisely, and have been actuated by a desire for increased personal authority, in the recent limination of many of the district's most experienced employees, including its attorney, consulting engineer, esgineers and assistants, mechanics, bookkeeper, purchasing agent and costkeeper, some of whom had been connected with the affairs of the valley for sixteen years. The majority of the directorate have now taken over a large part of the authority asd responsibility formerly delegated to the eliminated employees, and have shifted the remainder to less experienced men.

DURING the latter part of 1924, three of the five directors planned to rearrange the boundaries of the district's directors' divisions, with the purpose of eliminating two members of the board who were not in harmony with their program, and in so doing, passed a resolution to remove the general offices from Calexico to Imperial. This removal involved an expense of more than $100,000, which might otherwise have been devoted to necessary work on the system.

This action resulted in the elimination of one of the two directors at whom it was presumably aimed, and the election of a new director. The election of this new director was attacked in the courts, and by Judge Burnell was held to be invalid. On an appeal of this decision, the director is now holding office pending the decision of the California Supreme Court.

These moves were made for the purpose of economy, the majority of directors assert, but the writer and other critics of the policies believe that they were actuated by a desire for political power on the part o fthe responsible directors.

The present writer is prepared to show that this "economy" program in 1925, to the beginning of September, resulted in the following: a larger expenditure on the payroll than during the same period in 1924; a lack of co-operation among employees; unfavorable publicity, detrimental to the best interests of the Valley; reduction of the capacity of

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Department Urges Upper Stream Appropriations on Western Waterways

All interests on the upper reaches of streams in the Western public land states have been urged to take advantage of local topographic conditions, secure their water rights and make early appropriations for storage and division of irrigation and power development in an official statement by the Interior Department. The statement declares:

"It is the policy of the Interior Department to encourage and even to urge the impounding of the water on the upper reaches of all streams in the arid and semi-arid regions of the United States. The precipitation of moisture in any region is fixed within approximate limits and can not be increased. Water must be used more than once to secure the greatest benefit from a given supply.

"The result of scientific meteorological observations and stream measurements demonstrate beyond argument that except for consumptive use in plant growth and by evaporation, no water is lost when used for irrigation and power development, but it later returns to the stream and may be repeatedly used before the final return flow reaches the stream at its outlet, but water first applied far down the stream is forever lost to use above the point of diversion. High diversions automaticaly simplify administration of water rights, which in the past have led to so many dissensions between neighbors, court-adjudication of rights, and litigations between States; interminable, costly, and delaying development of the West.

"If diverted first to the lower areas in the watershed its re-use will be curtailed and often lost forever for beneficial purposes. Irrigation in the upper reaches of a stream acts as ground storage, equates the seasonal run-off of the stream below, and can be again and again diverted or stored for irrigation or power purposes as far down as opportunities exist.

"The Department would urge *all interests in the upper reaches* of such streams to take advantage of topographic conditions, secure their rights, and make early appropriations for storage and diversion for irrigation or power development, to profit by the opportunities of the pioneer in time and place for their own advantage and ultimate benefit to those on the stream below them. While there is no Federal embargo on the use of streams in reclamation, the absence of agreements between States interested, operates as an economic embargo and prevents the preparation of adequate plans for development."

High Dam, All-American Canal, Have Support of Administration

SECRETARY Hubert Work has submitted to the senate committee on irrigation and reclamation a report in which he recommends a plan of development for the Colorado River similar in its essential phases to that contemplated by the Swing Johnson bill, now before Congress.

It is understood that the plan favored by Secretary Work is put forward after frequent conferences between President Coolidge, Secretary Hoover and other members of the cabinet, and that it therefore carries administration endorsement with it.

His report recommends that funds for the development should be provided by a bond issue by the United States, and should be sufficient to provide for the construction of a dam approximately 550 feet high, an adequate power plant, and an all-American canal. The total cost, which he estimates would be $125,000,000, would be divided as follows: construction of reservoir, $41,500,000; power plant, $31,000,000; all-American canal, $31,000,000; interest charges, $21,000,000.

Speaking of the Swing-Johnson proposal, which had been referred to him as Secretary of the Interior for study and report, he stated: "The general plan and purpose of this measure has my support, and I favor it being made a national undertaking, to be carried out and administered by the federal government."

TOUCHING the disposal of water and power by the government, the report says:

"The water so impounded should be sold to cities requiring it for domestic purposes and other municipal uses and to irrigation districts, like that of the Imperial Valley, desiring a complete or supplemental water supply under the provisions of the Warren Act, payment to be made for a definite volume of water each year.

"The electric energy generated should be sold to the highest bidders, with due regard to public interest, at the switchboard of the power plant. Contracts should not exceed 50 years in duration. Transmission of power and its distribution to be provided by the purchasers.

"Water supplied for domestic, industrial or irrigation uses should be delivered at the dam, at points along the river agreed upon and at the terminal of the All-American Canal.

"Prices for this water should be such as to at least repay all of the cost of operation and maintenance of the canals and an equitable part of the operating expenses of the dam. This with the revenue from power will, we believe, repay the entire investment in this development, with 4 per cent interest."

Referring to the All-American Canal feature, the Secretary believes that "the necessity for the All-American canal, and size and cost of this canal, depends largely on whether the existing concession under which water is now diverted from the Colorado River at Hanlon's Meading and carried through Mexico to irrigators in the Imperial Valley can be modified. If it can not be, then the All-American canal becomes an indispensable part of this development."

TWO important provisions are recommended by the Secretary's report bearing upon the relation of the proposed plan to the rights of the states under the Colorado River compact, as follows:

"Section 8, which provides for the distribution and use of all water for irrigation, power and otherwise, in accordance with the Colorado River compact, seems well conceived and is a necessary part of this legislation. This appears to afford ample protection and assurance to those states included in the upper division of the watershed against the creation of a priority of right through the building of these works, which would impair in any way their right to the volume of water guaranteed to that division in the compact. I suggest for consideration, amendment to the effect that the benefits to be derived from this development shall be available only to those states or the citizens of those states which have ratified the compact.

"I suggest the following proviso be inserted at the end of section 10 of the bill:

" 'Provided, however, that no work shall be begun and no monies expended on or in connection with the works or structures provided for in this act until the respective legislatures of at least six of the signatory mentioned in section 13 hereof, shall have approved the Colorado River compact mentioned in said section 13, and shall have consented to a waiver of the provision of the paragraph of article 11 of said compact, making the same binding and obligatory when it shall have been approved by the legislatures of each of the seven signatory states, and until the President, by public proclamation, shall have declared that the said compact has been approved by and become binding and obligatory upon at least six of the signatory states.' "

THE HYDRAULIC DIGEST

A Monthly Bulletin Board of Brief Facts and Events from Far and Near

Form New Idaho District

By a vote of well over the required two-thirds, voters of the lower Boise project lands in Idaho recently approved the proposal to form an irrigation district, to supplant the Payette-Boise Water Users' Association as the governing body for the Boise project. The vote was 906 to 310.

Vote to Dissolve District

By the margin of a single vote, the electors of the Salmon River (Idaho) Irrigation District have decided to dissolve the district. The district was formed two years ago for the purpose of issuing bonds to acquire the Salmon River project irrigation system, but nothing has been accomplished in this direction.

Vista System on Schedule

That the new irrigation system being constructed for the Vista Irrigation District, Southern California, will be completed on schedule time, and will be available for the 1926 irrigation season was reported to the directors at a recent meeting by Kenneth Q. Volk, chief engineer. The main canal is now more than ninety per cent complete.

Forming Montana District

Farmers in the vicinity of Hobson, Montana, are undertaking the formation of an irrigation district with the purpose of storing flood waters of the Judith River and Antelope Creek in the Acly lake region. The contemplated district would include 15,000 acres. Preliminary surveys have indicated that the plan is practical.

Power Development Urged

Engineers and executives of the Elephant Butte irrigation project are urging that a program for the development of power from stored waters of the project be undertaken and vigorously pushed. It is also proposed to construct a subsidiary storage dam at Las Palomas for the storage of water released by the big dam not needed for irrigation.

Purchases Melones Townsite

Twenty-seven acres on which the old historic town of Melones is built has been purchased by the Oakdale and South San Joaquin Irrigation districts. The town will be inundated when the Melones dam is completed. The directors of the two districts also jointly accepted the eight and one-half miles of railroad built by the Mathews Construction Company from the Sierra Railroad to the dam.

Reduce Service Charge

A flat charge of $1.00 to water users of the Imperial Irrigation District for each time water is ordered and delivered, established by the directors of the district as effective for 1926, has been reduced to a rate of twenty-five cents per day for the period during which water is run during the year. The change was made in the interest of small users who require only a limited amount of water, but at frequent intervals.

Drainage Congress Meets

The Fourteenth National Drainage Congress is meeting in January at Oklahoma City. A program of addresses and discussions by nationally prominent representatives of land reclamation, developing, financing, flood control, drainage and related problems will be enjoyed by several hundred delegates. Special attention will be given to the matter of land settlement. The congress will be in session for three days, beginning January 18.

District Plans Improvements

Improvements costing nearly $100,000 have been authorized by the Palo Verde (California) Irrigation District. The Union Iron Works of Los Angeles has received a contract providing for the erection of a steel shop building and warehouse for the district, and Caldwell & Richards have been given a contract for the renewal of a jog in the Colorado River at Ferry Bend. The district will spend $55,000 in widening and extending its canal system.

Reclamation Fund Grows

The federal Reclamation Fund was increased $180,217.32 through receipts from the sale of public lands including fees and commissions covering the third quarter of 1925. The largest receipts for the fund came from the State of Utah, the amount being $47,157.26. The second largest receipts were from Washington, with $23,113.75, while the third were from Wyoming, with $18,161.41.

Conservancy District Reduced

From more than a million acres, the area of the Middle Rio Grande Conservancy District will be reduced to about 400,000 acres, if a report submitted to its board of directors at the close of the year is accepted and acted upon. George M. Neel, state engineer of New Mexico, and two other prominent engineers of the state prepared the report recommending the exclusion of the largest part of the district as territory which they believed is non-reclaimable.

Complete Big Private Project

The American Beet Sugar Company, Oxnard, California, has completed its big private irrigation and drainage project in Ventura County. A year's work and an expenditure of half a million dollars are involved. Forty-five miles of drainage ditches, seventeen wells, varying from 350 to 1030 feet in depth, and other construction features in proportion, were includeded in the project, which will develop more than 2000 miner's inches to be used on the 7500 acres of A. B. S. holdings.

Final Step in Merced Work

Work has been begun on the final undertaking in the task which, completed, will bring water to 200,000 acres of the Merced (California) Irrigation District. Directors of the district have instructed their engineers to clean several miles of the main canal of the district and to provide for the enlargement of the tunnel, through which water from the Exchequer dam will be carried upon its completion. An expenditure of $200,000 has been authorized for this final step of the big job.

Washington Votes for State Aid In Settling Projects

Banker Bill Fails; Compromise Measure Opens Way for Approval of Kittitas Contract

After a vigorously contested fight in the Washington state legislature, during which the "Banker" bill (so-called from the name of its author) passed both houses but was vetoed by Governor Hartley, a compromise measure was enacted and received the governor's signature, paving the way for the execution of the contract between the state and federal government which insured the beginning of work on the Kittitas project.

The compromise law, which was passed as an emergency measure to take effect immediately, authorizes state co-operation in the settlement of projects, when the state is indemnified against loss by a contract with the individual irrigation district. As passed, the act is of a temporary nature, designed to secure immediate action on the Kittitas project. After June 1, 1926, special appropriations will be necessary for each district taking advantage of the bill.

The measure provides, in part:

"Section 1. That any irrigation district by and through its board of directors is hereby authorized and shall have the power to enter into a contract with the State of Washington whereby it shall agree to indemnify the State of Washington against any and all obligation and liabilities which may accrue against the State of Washington under any contract between the State of Washington and the United States relating to land settlement in said district.

"Sec. 2. Any such irigation district which shall have entered into any such contract of indemnity with the State of Washington is hereby empowered and shall be required to levy assessments against all the property within said district from time to time and in such amount as shall enable it to reasonably anticipate and promptly comply with its said contract with the State of Washington. Such assessments shall be levied and be payable at the time and in the manner that its regular assessments are made and shall have the same validity, force and effect as assessments for any other purposes. Such assessments shall be levied for and shall be paid into a fund, to be known as 'The Indemnity Fund, and such fund shall not be used for any purpose other than to fulfill its obligations under its indemnity contract with the State of Washington."

The bill makes it mandatory on the director of conservation and development to execute a contract on behalf of the state if agreed upon between the federal government and an irrigation district by June 30, 1926. After that date all reclamation contracts between the state and federal government must be approved by the legislature.

Mokelumne River Plan Under Fire From Manufacturers

The Mokelumne River project of the East Bay Municipal Utility District, (described in this issue by Arthur P. Davis) is being opposed by a faction in the East Bay region constituted as the Manufacturers Water Committee. The thirty-nine million dollar project was authorized by bonds voted more than a year ago, but the opponents of the plan are now urging a referendum. J. H. Millar is chairman of the Manufacturers' Committee.

Dr. George C. Pardee, president of the District, characterized as "laughable" the contentions of the faction opposing the carrying through of the scheme as outlined by Mr. Davis, whose consultants were such well-known engineers as George W. Goethals and William Mulholland.

"The East Bay Municipal Utility District directors are unanimously in favor of the Lancha Plana reservoir, and our confidence in the integrity and technical knowledge of the engineers who selected it is unbounded," declared Dr. Pardee.

Court Rules on Moot Point in Tulare District Case

Holds Judge Justified in Suspending Operation of Injunction Pending Appeal From Judgment

The Supreme Court of California recently decided an important point of irrigation law when it ruled, in deciding a point arising in the litigation between the Tulare Irrigation District and the Lindsay-Strathmore Irrigation District, that the Superior Court, in the exercise of sound discretion, is entitled to suspend the operation of an injunction to which it has determined that the plaintiff is entitled, pending an appeal from the judgment.

Superior Judge Albert Lee Stephens, before whom a re-trial of the case was heard, found for the plaintiffs, the Tulare Irrigation District, but, on motion of the defendants, suspended the operation of the injunction pending appeal. It was on this point that the case came to the Supreme Court, on an application for writ of prohibition, prayed for by the Tulare Irrigation District, to be directed against Judge Stephens and his court.

Action was commenced in July, 1916, by the Tulare District, which sought a permanent injunction against the defendant, restraining it from pumping water from a tract of land in Tulare County, to which the plaintiff claimed right. The trial of the case in the first instance resulted in a mis-trial, and on re-trial before Judge Stephens, the judge filed and signed his conclusions of law in favor of the plaintiffs, but before he entered his decree announced what his decision would be, and granted the motion of the defendant for a suspension of the operation of the decree pending appeal from judgment to the Supreme Court. The higher court concluded in its decision that the right of the judge in this case to supend the operation of the injunction was essential to the preservation of the right of appeal.

W. I. E. A. Meets in Los Angeles In Important Session

Two Business Meetings and Evening Banquet Included on Program for January 22

Beginning the new year with a meet that promises to be full of interest "from invocation to benediction," the Western Irrigation Equipment Association will hold its regular January meeting in Los Angeles, at the Hotel Alexandria, on January 22nd.

Two business sessions during the day, and a concluding banquet in the evening, are included on the program. The business sessions will be called to order, at the hotel, at 10:00 a. m., and 2:00 p. m. respectively, while the banquet will begin at 6:30. The morning meeting is for the executive committee only.

Some very important matters of business will come before the Association at this, the first meeting of the year, including consideration of the standard guarantee contract form, presented at the last meeting for the study of the organization and action at this session.

In a letter sent out by Secretary C. A. Utley, the entire membership is urged to set a new attendance standard at the January meeting by coming "one hundred per cent," with a knowledge of the matters before the association for action.

George W. Bigelow, of the Pacific Pump Works, Los Angeles, is chairman of the committee on arrangements for this meeting. B. A. Tucker, sales manager of the same company, will preside at the banquet as toastmaster. The principal speaker of the evening has not yet been announced, but will be a leader in irrigation development of the southwest, capable of speaking the language of the association, and will bring to the members a message of universal interest.

MANAGEMENT

WHAT ARE NEW MEXICO'S GREATEST IRRIGATION NEEDS?

By GEORGE M. NEEL*
State Engineer of New Mexico

MANY of the water uses of the State of New Mexico date back to the ancient Indian or early Spanish days. Naturally enough, these canals are simple diversions and were built with but one idea in mind, namely, to supply water to some one locality or settlement, and in no case was any attempt made to eliminate duplication of headings of canals.

The irrigation development in later years has, to a large extent from necessity, broken away from the earlier methods. These later developments are characterized by more expensive and more permanent construction, larger areas on which to saddle the cost of the works and an ever-increasing amount of storage to insure the water supplies.

Probably the greatest difference between the irrigation conditions in New Mexico and those of most other irrigation states is that here a large part of the normal low-water flow of its streams is covered by these simple and primitive canals, which seem almost sacred before our legislatures and our courts. Fundamentally they are entitled only to that water which they can use economically and beneficially. However, there is much room for accomplishment in the consolidation of duplicating features and a stricter administration in accordance with modern practice.

A CASE in point of what can be accomplished by reorganization and reconstruction is the Rio Grande Project of the Federal Government. Before its construction there existed in the valley now covered by it the old haphazard canals with no co-ordination and subject to the shortages of water in years of low run-off, while *now* all operations in the valley for one hundred and fifty miles are co-ordinated as one unit. As will be readily seen, these old canals have little value toward the reconstructed system except such water rights as they may have and the fact that the farms are to some degree going concerns and the settlement problem is partially eliminated.

The continued advancement of irrigation in New Mexico and gradual approach towards its limits because of the limited water supply, presents the increasing demand that future developments be based on comprehensive studies of stream systems as a whole. The science of irrigation has made notable strides in the last twenty-five years and seldom has the Irrigation Engineer with the present broadened conception, had the opportunity to plan the whole development of a stream system untouched by prior piecemeal development.

All new development must be approached from the broad and comprehensive viewpoint. Both capital and the success of a project now instituted demand that all the various phases be studied and alternative plans developed and final selections based on future as well as present conditions.

MOST of our larger streams are interstate in character and until the last few years development has proceeded on them with little thought of rights which are being initiated on the opposite side of a state line, and it has been the tendency to believe there was water available so long as there was an apparent surplus in the stream. We are awakening to the realization that what is taking place in our neighboring state on a stream which also furnishes us with water is our vital concern. From this has come the need of interstate understandings and recognitions.

Even the most ardent advocate of states rights in the matter of taking water which flows within its borders must admit there is a point, beyond which he cannot rightly go in appropriating to himself water which is the recognized supply of an old established community. In these matters a state's attitude may be unintentionally influenced by the fact that it is an upper or a lower user.

It is the writer's belief that New Mexico's greatest and most outstanding need for future ultimate and comprehensive development in irrigation can be stated under two heads:

First, a determination of all present rights, both inter and intra-state, and a fair allotment of any surplus waters on interstate streams as between the states involved.

Second, such changes in the state laws as will permit an individual user to expand his area irrigated without using a greater amount of water, thus encouraging a higher duty of water by giving to that individual the savings effected by himself.

** A paper presented to the December meeting of the Western Division of the Chamber of Commerce of the United States.*

Oregon Drainage Congress to Merge with Reclamationists

Two Organizations Join Forces for Advancement of Reclamation Activities of State.

The Oregon State Drainage Congress, meeting at Salem, Oregon, in December, voted to accept the invitation of the Oregon Reclamation Congress, extended at the time of the annual meeting of the latter organization, to merge with it and combine the identities and activities of the two bodies whose purposes are so closely allied.

Governor Pierce of Oregon was one of the principal speakers before the annual meeting. He emphasized the importance of drainage and irrigation as the future food producing factors of the nation, and discussed some of the major problems facing Oregon.

F. Lair Thompson, prominent Portland attorney, made a plea for the elimination of politics from irrigation development, and urged the appointment of a non-partisan committee to study the irrigation district problem of the state. He also advocated the expansion of the strictly agricultural activities of the Oregon Agricultural College.

21 PACIFIC PUMPS for CHOWCHILLA FARMS

THE United States Farm Lands Company of Chowchilla, California, has purchased twenty-one Pacific Pumps to be used in the irrigation of extensive ranch holdings in Madera County. Thorough and widespread investigation preceded this decision, and the order was given upon the unquestionably superior construction and efficiency of Pacific Pumps.

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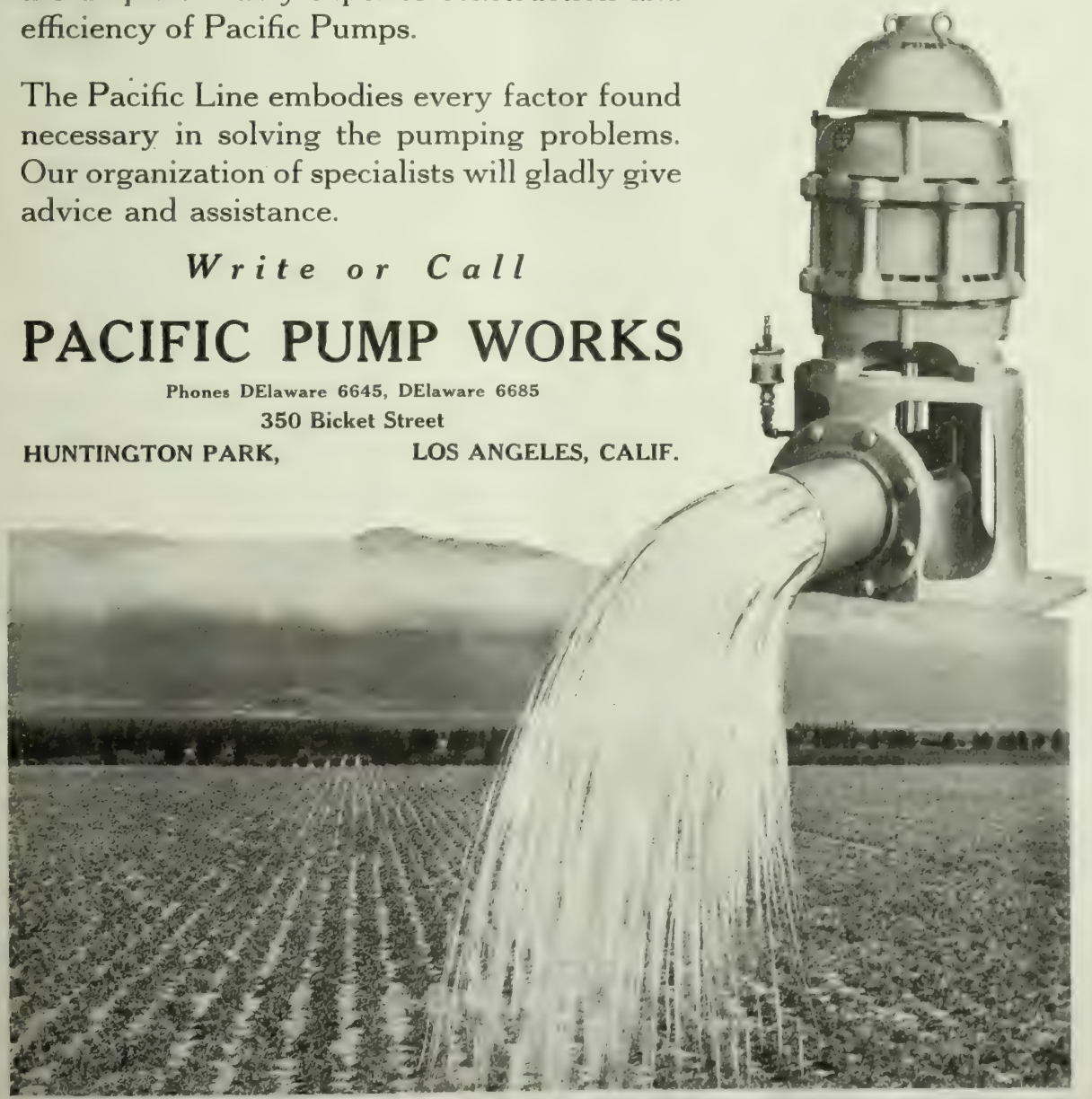

For Detailed Listings, Branch Offices, Etc., See the Buyers' Guide to Leading Supply Sources—Pages 55-56

TWO FUNDAMENTALS—SEED BED AND SOIL MOISTURE

By HARDY W. CAMPBELL
Farm Advisor, Southern Pacific Company

THERE are two fundamentals in tillage that my thirty-five years of close observation and experiments have brought out as vital factors in the production of large crops of vegetables and grains—whether *with* irrigation or without.

Correct seed bed preparation is by far the most important problem in all successful crop growing today. In using the word "successful" I have in mind the production of a very material increase per acre over the present average yield, for it is the key to increased farm profits.

The careful preparation of the seed bed is the basis for bigger crops when correctly carried through; but it does not, as may be supposed, necessarily mean a material increase in cost of labor, because the kind of work done, time of doing the work, and soil moisture conditions, are of greater importance. It is a fact that much of the work and present methods are wrong and cannot produce the desired conditions for the big possible yields. Every farmer is proud of what he does well; consequently he will do twice as much with less fatigue. No farmer is proud of what he does not do well; therefore, he turns from it with disgust and imagines himself exceedingly tired. The work he has done comes to nothing for want of the real finish which may be only a little, but, if intelligently done, would not only have added faith, profit, courage and happiness to his farming efforts but would have lent an encouraging influence to his less hopeful neighbor.

AFTER the preparation of the seed-bed, the most vital factor is the ability to control and utilize the soil water to the highest degree of efficiency in the production of large yields. This depends very much upon the physical condition of the soil, brought about by the various acts of tillage. While conservation of soil water is important, remember its complete utilization is the big profit-maker. There is much evidence that there is a serious waste of soil water, both with and without irrigation, under the present more common practice. A thing that the average farmer does not understand is the immense value of timely tillage of the right kind.

It is the writer's candid opinion, supported by his more recent years of continued observation and experiments, both with and without irrigation, and over a wide scope of country, including a large variety of soils and climates, that the real condition of the seed-bed and the per cent of moisture it carries for several days prior to planting is the big governing factor. In other words, I am compelled to conclude that in all cultivated fields there is a certain important relation of the various soil particles, one to the other, from the very topmost down, that has been quite completely overlooked in the past. There is a certain precise arrangement of these particles that does regulate, very largely, that necessary combination of air and water in the soil. Certain soil conditions carrying (as they will where moisture is properly conserved) that high per cent of moisture with the desired low per cent of air lay the formation for the process—then, when the desired certain degree of warmth is added, there will follow in a very few days the development and growth of that most wonderful and valuable soil bacteria—nature's own fertilizer, or plant food—the real stimulating power behind the growth of all healthy plants. Therefore, the correct rearrangement, by timely tillage, of the soil parts will add to the soil's efficiency and increased producing power to a marvelous degree.

In short, as with the radio, the correct combination and adjustment of all parts brings the pleasing results.

HERE is the big point, to keep in mind, but expressed in a different way: If the seed-bed is put in a very fine, firm condition, early in the winter or as soon in the spring as frost and moisture conditions permit, and the soil just beneath carries the higher per cent of water, and a shallow dry mulch is quickly put and kept over the surface; then, as soon as the soil begins to warm up, nature's first and most important action in the growth of a big crop begins, in the way of increasing the available plant food. Not infrequently, quite early in the spring, although not perceptible to the naked eye, there will be millions of minute little plants growing in the upper or warmer part of the seed-bed, known as "soil bacteria." This is Nature's fertilizer, which does not have to be bought by the ton but is delivered, free of charge, if you proceed at the right time and in the correct manner in the preparation of the necessary favorable soil conditions for its development and growth. This procedure means much to garden and vegetable fields.

When Progress Came to the Peaceful Valley of Content

(*Continued from Page 19*)

tervals throughout by three-quarter inch steel rods, the apron walls being concreted over heavy wire meshing. During construction, ample provision was made—in anticipation of Willits' rapid growth—for raising the water line of the lake. This was done by extending the steel bars above the crest of the dam that proper bonding with the new and old levels of the reservoir could be accomplished.

ORIGINALLY designed on a 50-foot elevation basis, it has already become necessary to plan the addition of another 10 feet to this height, thus raising the water line, changing the contour of the lake and the topography of the surrounding watershed considerably. Various picturesque points and little peninsulas jutting out into the lake will become all or partially submerged, and there may be created even a miniature island or two.

Nor have the plans halted at the 10-foot addition contemplated for the immediate future. It has been estimated that the yearly run-off from the watershed surrounding the dam is in excess of 50,000 acre-feet. This fine surplus can and will be impounded for irrigation purposes for the valley and town of Willits, the dam being gradually raised to keep pace with the constant growth of supply and demand. If the dam eventually be raised to an ultimate 100-foot height, the storage capacity of the lake area will be more than 5,000 acre-feet; in other words, one and a half billion gallons of water will be available at all times.

Not only will the Mendocino valley derive water for irrigation from this structure, but the impounded waters of the Morris Dam insure a greatly improved fire protection, as well. This, in turn, reacts favorably on the reduction of insurance rates. A new 14-inch slip joint steel pipe line, with a capacity of 1,800 gallons per minute under 64 pounds pressure, connects the dam with its distribution mains. An ingenious

system of gates delivers water into the mains a little more than 100 feet from the main structure. All this is of cast iron pipe construction, and the reservoir drain and supply line feed are under gate control. Back-pressure gates in series take care of the flushing of the entire system whenever necessary. The main leads from the dam consist of 12-inch cast iron pipe, one located 10 feet from the bottom of the base wall, the other outlet being 15 feet from the top. These outlets lead to the gate house 108 feet from the dam, where control gates deliver water into the mains.

The construction of the Morris Dam has been notable for its economy—the natural lake setting, the narrow gorge at the lower end of the site, flanked by the ready-made walls of solid rock, the consistent slope of the land toward the mouth of the dam, and the fine sedimentary nature of the soil through which the pipes were laid from the dam to the town—all these features favoring the builders. Nor was this all—for they acquired franchise to give the right-of-way over roads, thus insuring even more economy in maintenance facilities, for the mains follow the road into Willits, and are thus always easy of access for repairs.

In carrying out the present design, less than 2,500 cubic yards of concrete will be required to raise the dam to 100 feet. This estimate is borne out by the fact that only 800 cubic yards of concrete were used in constructing the initial half-hundred feet, which, all in all, considering its huge storage capacity, makes the Morris Dam a distinctive achievement in water engineering in the West.

Imperial District Announces Budget Estimates for 1926

Estimated expenditures of the Imperial Irrigation District for 1926 will amount to $3,062,600, according to the budget announced by the general superintendent. The largest items are: water distribution, $1,237,350; bonded indebtedness, $1,042,000; real estate, building and equipment; $120,000; diversion, $238,000.

The superintendent's bulletin explains the plan for assessment in 1926 as follows: "Each acre of land pays an assessment at the rate of $5.00 per $100 valuation. For that assessment it receives all the water needed without any additional tolls, except the service charge. This service charge of 25 cents per gate per day water is delivered is required to pay for the zanjeros and hydrographers. It is levied on the theory that it costs the District just as much to operate the delivery boxes for a small flow of water as it does for a large flow."

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HYDRAULIC ENGINEERING

Dealing with the Practical Problems of the Operating and the Consulting Engineer

THE AGRICULTURAL ENGINEER'S PLACE IN RECLAMATION

By O. V. P. STOUT*

Division of Agricultural Engineering, Bureau of Public Roads, U. S. Department of Agriculture

I TAKE the term "Reclamation" to cover the process of bringing to a high grade of usefulness in crop production lands which at the inception of the undertaking are either in an unproductive state or are of inferior or limited capacity to produce.

This definition, if acceptable now, would have been equally so if proposed twenty-five years ago. The range covered by the definition would not, however, have been realized in the earlier period. The oprations now acknowledged to be embraced in reclamation are many more than were generally assigned to it at that time, and we have come to know that the process of reclamation does not terminate nor become assured of completion where and when we assumed that it did. We have had forced upon us the fact that it is not complete until the land has been subdued, in all that the term subdue implies, and brought to an advanced and complete state of cultivation and production; and not until there is on the land a full complement of adequate farm homes and well planned farmsteads, with the ownership on a secure financial and economic basis.

There are a multitude of different states or conditions in which land may be found or into which it may fall that offer a field for reclamation. It may be either permanently or at intervals or seasons too wet or too dry. It may be too strongly impregnated with mineral salts, or it may carry the refuse of industrial operations. It may lack elements of fertility which it is practicable to introduce and maintain. It may be covered with growths which impede or inhibit cultivation. The remedy in some cases calls for community or corporate action. In others there is opportunity for complete independent procedure within the scope of operations of the individual land owner. In nearly all instances, under all of them in this country, up to the present time, the ultimate steps to reclamation have depended on the owner or occupant of the land, acting in his individual capacity.

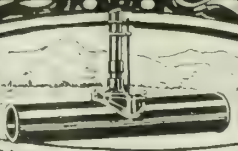
AGRICULTURAL engineering is the industrial branch of engineering which concerns itself with agricultural production. The economic purpose of reclamation is agricultural production. Therefore, we incline to assume at once that there is a field for the agricultural engineer and the American Society of Agricultural Engineers in reclamation. However, if we attempt to envisage their field as co-extensive with the engineering of reclamation we find some material overlaps, with some of the fundamental branches of engineering in position to assert claims of priority of occupation. The science and the art of the design, location and construction of works to water arid tracts of land have been developed almost entirely within civil engineering lines. Much of the progress in America has been accomplished within a comparatively recent period, so that whereas no longer than thirty years ago we had to turn to foreign countries for models of excellence and precedents of magnitude in irrigation engineering, we now find America able to show examples which are second to none. The record of these achievements and of the scientific considerations on which they are based and which have been developed in connection with them have been given attention in the papers and discussions at the meetings of the American Society of Civil Engineers and in publications.

Thus it seems that the case of priority of occupation of the field of irrigation works of magnitude is clearly established. If priority were all, however, and it could be shown that the agricultural engineers in sufficient number and with a training superior for the purpose would soon be available to render an even higher grade of service than that which has been noted, then the principle that "the first in time is the first in right" might not apply with sufficient force to prevent the agricultural engineers from moving to take over the field. There is nothing in the situation to give support to the idea of such a development, and I have to learn that it has been entertained. In the colleges the students n the professional agricultural engineering groups are given instruction in irrigation engineering, and there is no reason why with later experience of the right kind, some of them may not become engineers of large irrigation works.

But this is merely an aspect of the case as it applies to individuals. The group trained primarily as agricultural engineers is not that from which the supply of engineers for these larger works will be drawn, nor is the American Society of Agricultural Engineers the organization which, in the nature of things, is the logical one to assume the burden of future progress in the growth of the organized body of knowledge relating to the engineering of large works for reclamation by irrigation. Such being the case, it seems appropriate and desirable that any contributions which members of this Society may be able to make to this particular body of knowledge should be made through other channels, and that this Society should not invite nor encourage such contributions to its proceedings.

THE SITUATION in respect to other large works of reclamation, including drainage and flood control, is manifestly similar to that which obtains in connection with irrigation. That is to say: the province of the American Society of Agricultural Engineers does not extend to include the design and construction of the largest ways and structures. There is this, however, to be said, just as in irrigation, that in the decision as to capacity requirements of these larger works the qualified agricultural engineer will prove a most valuable consultant and in many cases the decision should rest with him. It fol-

*This article is an excerption from a paper delivered by the author to the December meeting of the California Section of the American Society of Agricultural Engineers.



ACCURATE WATER MEASUREMENT PAYS

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lows therefore that the capacity requirements of reclamation works of whatever size or character is a subject within the field of this Society.

What, then, some may inquire, is left for agricultural engineering in reclamation? And is agricultural engineering to be awarded only the leavings and the smaller items of reclamation engineering? In a way this is the fact. But a little consideration will show that this fact gives neither the agricultural engineering profession nor the American Society of Agricultural Engineers the least occasion for despair nor to be ashamed. The main canals and distributaries, dams and diversion works, tunnels, flumes, U-tubes, wasteways, checks, regulators and all principal ways and structures will be of no avail in the accomplishment of the reclamation of the region or tract for which they have been constructed until the supplementary ways and structures have been provided, the unfavorable topographic features of the land surface to be irrigated have been altered to conform to the requirements for best results in the application of the water, and from amongst the multiplicity of existing and conceivable farm systems of irrigation one or another has been selected and installed on each farm or group of farms.

ALL OF THESE, together with the location and construction of community roads, farm water supply and farm sanitation, the layout of fields, farmsteads and centers, and the design of farm buildings, are matters calling for engineering service and direction in order that the best results from the standpoint of efficiency and economy may ensue in a finished project of reclamation by irrigation. Nevertheless, up to this time the mark of the engineer is missing from the most of them.

The tenor of present day discussion seems to warrant the expectation that there will be an immediate and continuing improvement in this respect. Such being the case, there opens up for the agricultural engineer and for his national society a field which, at the same time that it is largely made up of items which in comparison with items of the larger works may seem minor or petty, in the aggregate covers a range and forms a magnitude that can be expressed only in terms which are the complete antitheses of "minor" and "petty." Moreover, this field, due to neglect in the past to attach full importance to it as a theater of engineering endeavor, presents now, and for some time to come, more of an opportunity for the effective work of an engineering society than does the rounding out of the already advanced practice in large works.

Inasmuch as it has been shown to be important that the work of the agricultural engineer should attach to the finishing of an irrigation project, it follows that he should be on the ground at the inception of the project also, in order that he may assist in arriving at the judgment which should be formed at that time as to the practicability of completing, in due season, the entire process of reclamation. In this it will devolve on him to ascertain and interpret all of the facts and factors of the situation which have or may have a bearing on the feasibility of an economic agricultural utilization of the land. It becomes accordingly the part of the American Society of Agricultural Engineers to take the lead and direction in building up and making available an organized body of knowledge covering the subject of the agricultural feasibility of reclamation enterprises.

The operation and maintenance of an irrigation system presents problems equally as complicated and frequently approximating the same order of magnitude as those which attach to the planning and construction of the system in the first place. To a great extent they are of a nature which may with propriety be considered by the American Society of Agricultural Engineers and without danger of meeting resentment on the score of priority of another society in this detail of the field.

A consideration of the fields of reclamation by drainage and by flood control would develop a demarcation closely analogous to that which has been indicated for irrigation.

WHERE the primary operations of reclamation consist solely of those directed to the subduing of the land, and where this can be accomplished on adjacent small areas independently of each other, it does not appear that any priority of engineering occupation is encountered by the agricultural engineer or the American Society of Agricultural Engineers. The assignment of the engineering of reclamation of cut over lands, for instance, is therefore made without reservation to agricultural engineering.

Engineers have had a large part in the valuation of the properties of public utilities and the establishment of rates for service. Some of the most effective studies of these subjects have been made by engineers. Their analyses and conclusions appear in the publications of engineering societies, where it can be shown that many, in fact a considerable majority, of the principles which have become embodied in court decisions and in the rulings of regulatory bodies and which now govern in such matters were first conceived and formulated by engineers.

The assignment of the engineer to this work was at first due to his familiarity with its physical basis, but he has carried it forward to less tangible elements on the basis of his training and practice in analysis. There are already strong indications that engineers will play an equally important part in the development and formulation of the financial and economic principles which are to guide in the settlement of lands as a directed step in reclamation. As in the case of utility valuation, the proceedings of his national engineering society is the best place for the record and appraisal of his achievements in this line. The treatment of these financial and economic questions, together with a study and working out of appurtenant sociological problems, constitutes a field which, it seems, must be looked upon as wide open to any who can contribute anything of benefit, be they engineers of whatever branch or not engineers at all.

IN THE foregoing paragraphs the partition of the civil engineering phase of reclamation between civil and agricultural engineering has been foremost in mind, and the mechanical and electrical engineering phases have been passed over. The principal field of the largest pumps is in reclamation. The design of a pump as a whole, of whatever size or capacity, scarcely falls to the agricultural engineer, but the testing and study of these designs is within his province. There are features of design which agricultural engineers, on behalf of the users of pumps, are investigating and seeking to improve. The situation is much the same in regard to the farm tractor. It may be noted that although the tractor is by no means exclusively an instrument of reclamation it has extensive use in that connection and a leading type was first developed in connection with reclamation. The fact that the agricultural engineer is already identified with tractor development in general may have a bearing on this item. The construction and maintenance of small irrigation distributaries and drainage channels, farm ditches for both irrigation and drainage, and devices for the installation and maintenance of various types of farm irrigation and drainage systems call for specially designed machinery. It may well be that the agricultural engineer, as the user of these machines, is well qualified in many instances to originate or improve the design.

From these considerations it appears that the agricultural engineer is involved in the mechanical engineering phase of reclamation in such a way as to obligate this Society to keep open its proceedings to the treatment and discussion of me-

chanical engineering subjects such as these enumerated.

In connection with the electrical engineering phase of reclamation, the agricultural engineer will sèrve chiefly, although not exclusively, as a consultant to the consumer of electricity, advising him as to types and disposition of machines and distribution of load thereon, to the end of securing the maximum practicable efficiency in performance and the most economic adaptation to rate schedules. This justifies the Society in holding within its scope the comprehensive and detailed consideration of farm plants, and probably all but the largest plants using electric power for reclamation purposes.

Making Irrigation District Credit What It Ought to Be

(Continued from Page 18)

The state of Nebraska recently enacted a law which provides that an irrigation district may "fund" its warrants, notes or other indebtedness into a bond issue. This law also provides for refunding twenty-year bonds into bonds running not to exceed fifty years. It further provides that interest coupons shall automatically bear interest at the same rate as the bond, if not paid when due.

The funding feature is important for districts which have allowed a considerable amount of taxes to remain unpaid, resulting in warrants not being paid for two or three years. By adopting the funding plan the district is enabled to place itself on a cash basis, and if the savings in interest and discounts are taken into account it is certain that a greater effort would be made, on the part of irrigation district officials, to keep on a cash basis. However, if anything is to be gained by funding warrants and other indebtedness a definite system for the collection of taxes must be inaugurated. Otherwise the district may, in a few years, be again in arrears in the payment of its warrants.

It would be well for irrigation projects to adopt a slogan similar to the following: *This project has never defaulted in the payment of its obligations —no investor has ever lost by the purchase of our securities.* Such a slogan would become more valuable with the passing years. The securities of such project would become salable anywhere in the United States and would be on a par with other first-class securities.

There is no question but that such a condition can be realized if the landowners and officers of irrigation projects will definitely plan to establish and maintain credit for their projects.

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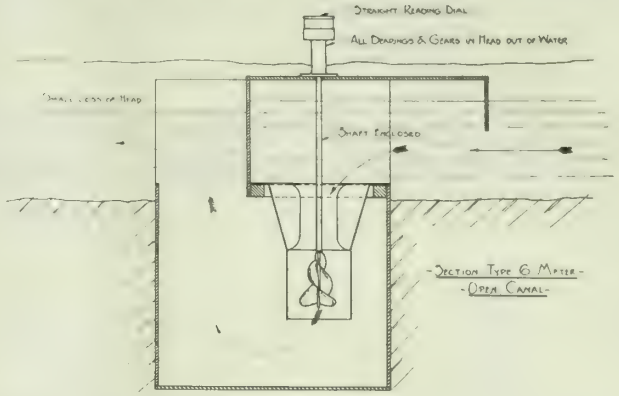

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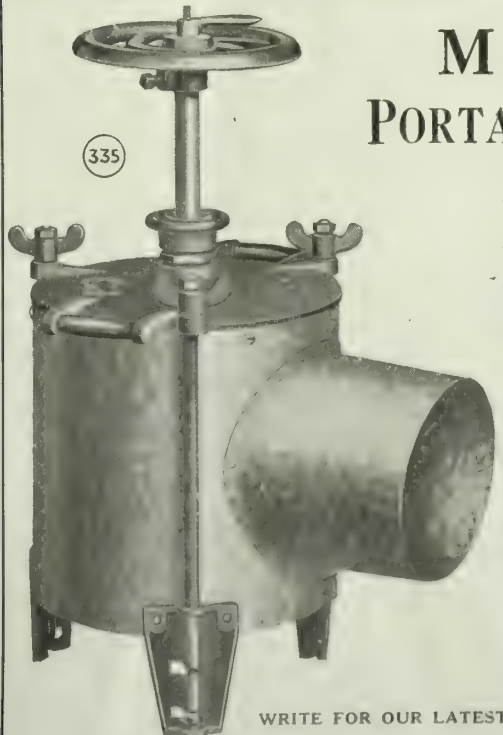

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WITH THE WATER COMPANIES

Of Interest Expressly to Water Works Engineers, Superintendents and General Managers

HOW THE RAILROAD COMMISSION HANDLES COMPLAINTS

By M. R. MacKALL

Hydraulic Engineer of the California State Railroad Commission

PUBLIC UTILITY water companies come in contact with the Hydraulic Division of the Railroad Commission most often through its informal complaint department. This department was organized by the Commission as a result of its general policy to promote a better understanding between the individual companies and consumers and to promote a spirit of cooperation in the general relations of utilities with their customers. While, in general, the Commission must make a formal order before it can legally demand and require compliance with its suggestions and instructions, yet there are so many matters that can be as readily solved informally, without the delay and expense attendant upon formal proceedings, that the Commission endeavors whenever possible to settle all complaints in this manner by correspondence between the parties or by personal investigation when the facts demand it.

During the last fiscal year the Commission settled informally 784 complaints as compared with the rendering of decisions during the same period in 179 formal proceedings requiring public hearings. The informal complaint department has developed into a branch of great importance not only as to economy in saving time and money for both utility and consumer, but also by speeding up of final settlement of complaints which otherwise would require formal action and decision by the Commission.

OF THE complaints filed with the Commission approximately 40 per cent involve disputed bills, 30 per cent inadequate or interrupted service, 20 per cent service installations and extensions of existing mains for service. The remaining 10 per cent cover complaints against the reasonableness of the rates or the classification charged, refunds under deposits, unjust rules and regulations, and the multitude of other causes which only a water works man can believe possible, including many that he honestly believes impossible as well.

It is a pleasure to be able to state that the complaints coming to the Commission are changing very definitely in character. There is a decided lessening from year to year in the number of trival compaints coming to the attention of the Commission. Only the more involved and complicated matters are now being referred to the Commission for settlement. This simply means that the water companies have generally adopted the broadminded attitude that good business demands every effort to meet the public fairly and honestly, and that the establishment of a good feeling with the customer through an earnest effort to settle disputes and complaints pays more than one hundred per cent upon the investment, in spite of the monopolistic nature of the business.

As a matter of fact this is well illustrated by the fact that the Commission will receive more complaints against some utility serving a community of perhaps two to five thousand in population than it will receive against the companies serving cities of over half a million population. In most cases this is due to the personal element rather than to service matters. The reason, of course, is obvious; the larger the utility, the greater is the realization that special efforts devoted to its public relations result in removing friction and reducing operating costs. The larger utilities have all found that special departments organized for the handling of this phase of their business is an absolute necessity.

ONE OF the greatest causes of difficulty experienced by the Commission in dealing with complaints is that involving the class of water systems installed by real estate operators to make possible the sale of lots. It is almost the universal practice for these operators to use the cheapest type of materials, adopting quite novel theories of construction, with inadequate sized pipe and usually with little or no storage facilities.

The difficulty arises in such cases when the cream of the lots is disposed of and the water system becomes a burden. Usually the water supply is inadequate, the service is almost unbearable, and the rates, already insufficient to pay a fair return upon the investment, can not be increased, for in most cases the charges are already all that the traffic will bear. The consumers of a public utility are entitled to continuous and reasonable service at a just price. The utility is entitled to a rate which will yield a fair return upon its investment. The Commission can not force any utility to operate its water system at a loss; to do so violates the 14th amendment to the Federal Constitution, which forbids confiscation of private property without due process of the law. This is a problem that is not only not rare but is a common every-day occurrence.

The solution of this particular problem is apparent to me in only one way, and that is to require the proper type of installation at the outset. Under existing laws this cannot be done. The counties and cities may grant a franchise to a company to construct a water system in the public highways, after which the company applies to the Commission for a public utility certificate. The cities and counties have no authority to demand certain standards of installation and service facilities. As a matter of fact the entire necessity for the procurement of a franchise is easily avoided by installing the water system before the subdivision is accepted by the authorities and the streets dedicated to the public use.

As to the withholding of a certificate to operate by the Commission for improper standards of installation, no such authority is apparent in the Public Utilities Act. The Commission itself is, necessarily, the greatest offender in this regard, for a majority of those applying for certificates for the operation of a water system have already been supplying a considerable number of consumers, in some instances for several years. To deny the certificate under these circumstances means that the existing consumers in 99 cases out of a hundred will be left

entirely without water service from any source whatsoever.

MATTERS of grave concern to the Commission as well as the water companies are those arising out of demands for service from an existing utility which require the extension of mains or other facilities. This is most acute in cases involving real estate subdivisions. In cases of ordinary extensions to individual consumers the Commission generally requires a water system to extend its mains at its own expense 150 feet for each bona fide consumer, the excess cost to be paid by the applicant, which is to be refunded to him in various ways when new consumers come on the line within a certain definite time limit. The fairest method of extension would perhaps be to expend a certain definite amount of money for each consumer. However, the varying conditions and the complications arising from keeping track of the costs, make this impractical. The 150-foot rule is the most simple and satisfactory in the end. The time limit for refunds, by the way, is of great importance. A period of not to exceed ten years appears to be fair to all parties.

Fortier, Adams and Etcheverry Are Advisors to Magazine

(Continued from Page 13)

number of smaller groups, including an irrigation section, of which he was chairman for a number of years. He also has membership in the following scientific and technical organizations: American Association for the Advancement of Science, California Academy of Sciences, American Society of Civil Engineers, and American Society of Agricultural Engineers. He is at present chairman of the Pacific Coast Section of the last named society.

B. A. Etcheverry

B. A. ETCHEVERRY is equally well-known for his activities in both the academic and practical fields of irrigation. He has been identified with one or another state university in the West since 1902, first in the departments of civil engineering and physics, successively as assistant and associate professor of irrigation, and finally as professor of irrigation engineering, which position he now holds at the University of California.

As an irrigation expert he has conducted some very important investigations for various irrigation interests, including an investigation on canal and reservoir linings and the use of concrete in irrigation structures, for the United States Department of Agriculture in 1906-1909; a report on irrigation conditions in British Columbia for the provincial government, 1912; an investigation for the city attorney of San Francisco on the use of the water of the Tuolumne River by the Modesto and Turlock Irrigation Districts, 1914-1922; an investigation of the use of the water of the Kaweah River, for the Lindsay-Strathmore Irrigation District, 1921-1924; on the use of the water of the San Joaquin River, for the Madera Irrigation District, 1921-1922; and a large number of reports on proposed irrigation and drainage systems, design for diversion dams and irrigation structures, plans for distribution systems, and many other miscellaneous investigations and studies.

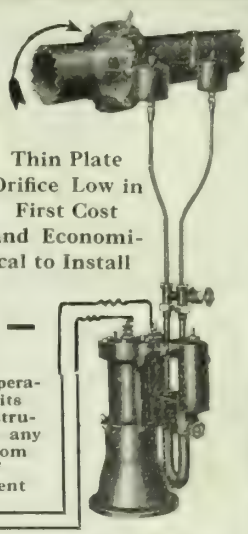
He has served as consulting and supervising engineer for the Kamloops Fruitlands Irrigation and Power Company, British Columbia; and in a consulting capacity for many irrigation organizations, including the Yolo Water and Power Company in the planning of improvements costing $350,000 and the appraisal of its irrigation system. In 1915 he was made chairman of the board of review for the adjustment of the construction charge of the Umatilla, Truckee-Carson, Klamath and Orland projects of the United States Reclamation Service. He has served as commissioner of assessments of several important western drainage and reclamation districts, and as member of a large number of official and semi-official bodies interested in the conservation and development of western water resources. He is author of a standard work, in three volumes, on "Irrigation Practice and Engineering."

Would Issue $700,000 Bonds

The Monterey County Water Works has applied to the California State Railroad Commission for permission to issue $700,000 of first mortgage 6 per cent bonds, at 94 per cent of face value, and to use the proceeds thereof to reimburse Del Monte Properties Company in the sum of $328,043 for the acquirement of said properties used by the water system and to provide itself with working capital and to reimburse its treasury for capital expenditures.

Big Crop Return on Rio Grande

The total gross yield of crops during the past year on the Rio Grande reclamation project in New Mexico and Texas including lands irrigated in the republic of Mexico totalled $12,605,000. The Elephant Butte and El Paso districts produced crops last year valued at $10,680,000. This is an increase of approximately $1,000,000 over crop returns of the previous year in spite of a $500,000 crop loss due to floods along the Rio Grande.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WHO'S *WHO* AND WHO'S *WHERE*

IN THE WORLD OF HYDRAULICS

Personal Notes and Impersonal Observations About Men You Know

John W. Scott, formerly connected with the U. S. Land Office in the Imperial Valley, has returned to the valley and will be employed in the office of the Imperial Irrigation District, at El Centro.

B. W. Oppenheim of Boise, Idaho, has been engaged by the directors of the Warmsprings (Oregon) Irrigation District for consultation in seeking a plan and directing the work of the district in adjusting its financial difficulties.

R. B. Coglon, County Agent in Yuma County, Arizona, has resigned to accept a position in the Missouri extension service. J. P. Sexton, Jr., has been appointed County Agent in Santa Cruz County, Arizona, succeeding Lee H. Gould, resigned.

Earl C. Pound and Charles L. Childers, president and attorney, respectively, of the Imperial Irrigation District, have returned from Washington, D. C., where they have been observing legislative developments in connection with the Swing-Johnson bill.

Professor H. A. Wadsworth, of the Division of Rural Institutions, College of Agriculture, University of California, was a visitor in Southern California during January, completing the extensive studies on which he has been engaged for the past several months on the subject of overhead irrigation.

Hardy W. Campbell, farm advisor for the Southern Pacific Railway, is making a tour of New Mexico and Arizona, delivering a series of lectures on the utility of water. Mr. Campbell is a specialist in soils culture who has spent a life-time in close contact with agriculture in all sections of the west.

D. R. Redman, resident engineer of the U. S. Indian Irrigation Service on the Wapato project, will undertake on February 15 a tour of California, Oregon and Arizona, in an effort to increase his familiarity with the latest type of hydro-electric developments on irrigation projects in these states. He will probably spend about six weeks en route.

H. P. Pratt, of Seattle, accompanied by several other northwesterners concerned in irrigation finance, recently inspected the Attalia (Washington) Irrigation Distrct, conferring with the board of directors on its financial outlook. The committee represented the bondholders of the district, who are interested in devising some method of relieving pressing financial problems.

Francis Cuttle, of Riverside, California, prominent in work for conservation and forest protection in the west, is in Washington, D. C., in the interest of pending forestry legislation. He testified before the senate agricultural committee that the conservation of water, which the passage of the pending forest bill would materially assist, was an issue of paramount importance to Southern California.

C. H. Pease, secretary of the Lower Rio Grande Water Users' Association, and editor of GRAVITY IRRIGATION NEWS, official publication of the association, is spending the winter in California, making a study of the irrigation situation in the far west. In January he was in conference with officials of the Imperial Irrigation District, discussing problems of international interests in the Colorado River. He is interested in this subject on account of the problems of the same sort which exist on the Rio Grande.

Arthur S. Bent, of Bent Brothers, nationally recognized leader in the construction industry, has been elected president of the Los Angeles Chamber of Commerce for 1926, succeeding R. W. Pridham. Mr. Bent's election adds another to the already impressive list of official positions which he has held in influential organizations. He is a past president of the Associated General Contractors of America, and was the first president of the Southern California chapter of that body. He is also a national director of the Chamber of Commerce of the United States.

Officials of four states and a representative of the federal government met in December at Seattle, Washington, for a conference on a possible plan for allocating waters of the Columbia River between the states. Those participating in the meeting included: R. K. Tiffany, state hydraulic supervisor of Washington; C. S. Heidle, state engineer of Montana; Rhea Luper, state engineer of Oregon; W. G. Swendsen, reclamation commissioner of Idaho; Col. W. J. Barden of Seattle; R. F. Coiner of Portland, and J. L. Lytel, project manager of the Yakima project of the Bureau of Reclamation.

District elections of directors of irrigation and drainage districts of Washington were held during December, resulting in the naming of the following in their respective districts:

Okanagan, R. C. Rasmussen; Alta Vista, Leonard Rich; West Okanagan Valley, F. E. Teas; Whitestone, William Forde, R. A. Nixon and H. M. Hall; Riverside, George Hasbrouck, Philip Pfarr and Thomas Bailey; Richland, William Hellinger.

Sunnyside Valley, E. C. Houston and R. J. Core; Snipes Mountain, A. B. Delp; Kennewick, J. W. Vickers; Columbia, James Johnston; Burley, Joseph Morgan and Haven Leigh; Attalia, J. J. Cummings; Terrace Heights, H. S. Hauses and W. W. Drake; Wenas, J. B. Fink, Guy Longmire, and R. C. Babbitt.

Naches-Selah, John Dollebacher; Selah-Moxee, J. D. MacAuley; Moxee Drainage District, Edward Regimbal; Greater Wenatchee, Fred W. Hoffman; Wenatchee Reclamation District, William Greig; Millerdale, V. L. Garner, Marvin Chase, J. B. Daugherty.

Horse Heaven, Claude Young; Broadway, George Grist; Fruitvale Drainage District, J. Howard Wright; District No. 42, George L. Hunt; Lewiston Orchards, W. S. Thornber, P. E. Bishop.

Paul S. Redington Becomes Assistant Forester

Promoted to Washington Post After Score of Years in California Forestry.

Paul G. Redington, chief of the California district, United States Forest Service, has been promoted to assistant forester with headquarters in Washington, D. C. Mr. Redington will be head of the branch of public relations of the Forest Service which includes all co-operative work carried on under the terms of the Clarke-McNary Act, passed by Congress last year, providing for co-operation with states in fire protection, reforestation, a study of taxation and other important national forestry problems. Twenty-nine states are already co-operating with the Federal Forest Service in this work.

Mr. Redington, who is a graduate of Dartmouth and the Yale Forest School, first entered Federal forestry work in California in 1903. From 1911 to 1916 he was supervisor of the Sierra National Forest from which position he was promoted to district forester of the Southwestern District with headquarters at Albuquerque, New Mexico. In 1919 he returned to California as chief of the 18 national forests of that state, which position he has held to date.

He is vice-president of the Society of American Foresters; president of the San Francisco Departmental Club of the United States Department of Agriculture; chairman of the forestry and wild life section of the Commonwealth Club; an advisory member of the Southern California Conservation Association; the American Reforestation Association, the forest policy committee of the California Development Association, and the Commercial Club of San Francisco.

Mr. Redington will leave in the near future to assume his new duties. His successor in the California district has not yet been named.

Yolo Company in Straits

Unsatisfactory financial conditions of the Yolo Water and Power Company, as revealed in the hearing of a suit to foreclose a mortgage lien against it, resulted in December in the appointment of a receiver to take charge of the company's affairs. Suit was brought by the Oakland Bank to foreclose a mortgage lien against the company based on $9,900,000 in bonds and more than three million dollars in unpaid interest. G. H. Hoppin was named receiver to operate the business of the company pending its sale to the highest bidder on the open market. Judge M. S. Sayre, sitting in the Superior Court at Lakeport, heard the case and named the receiver.

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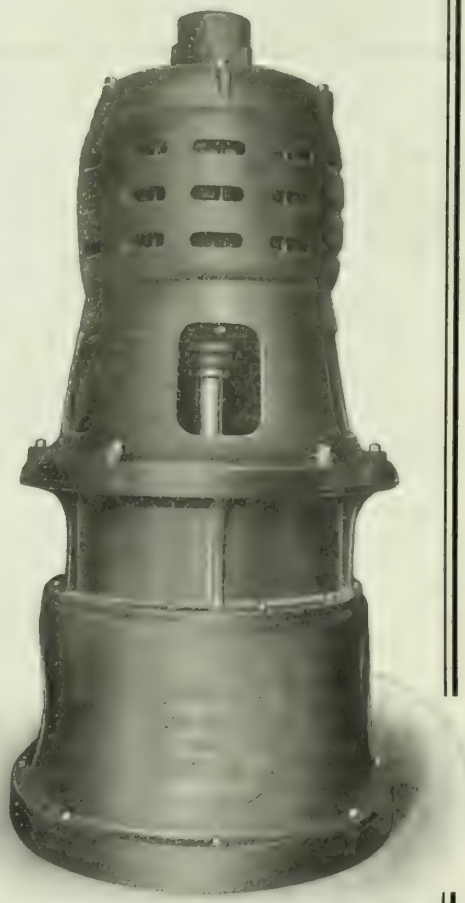

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RECLAMATION

NATIONAL MAGAZINE ANALYZES RECLAMATION TROUBLES*

AT THE ROOT of the reclamation difficulties which have assumed the proportions of a national problem is the traditional acceptance of Uncle Sam as a beneficent Santa Claus, believes French Strother, Associate Editor of WORLD'S WORK, writing in the January issue of that magazine under the heading: "The End of Uncle Sam as Santa Claus: Why Secretary Work is in Trouble with the West Over Reclamation."

Recapitulating the history of the development of the American continent, Strother points out that the role played by the federal government, from its inception to the present day, has been that of a generous and open-handed giver of free lands and other emoluments; and that the west has been the recipient of most of these benefits. It was not strange, therefore, that the policies of national reclamation should have been at first mistaken by their beneficiaries as another indication of federal munificence. But, avers this writer, reclamation was not intended merely as a channel for outpouring money in the interests of whomsoever might desire it, and when the rude but inevitable awakening occurred, the trouble began.

Mr. Strother briefly reviews the history of reclamation, as follows:

"IN 1902, Congress passed the Reclamation Act, popularly known at the time as the Newlands Act, from the name of the Nevada Senator who wrote it. Theodore Roosevelt was President, and the West was much in the public mind as a result of his vigorous advocacy of conservation. The reclamation of arid lands appealed to the popular imagination as a truly American conception, of wresting from nature another of her guarded treasures and, by enterprise, engineering skill, and vast expenditure, to make the desert blossom as the rose. The traditional land buyer of westward pioneering America also lent a sentimental interest to the plan. 'Free land' was becoming scarce, and the government at Washington (ever the giver of gifts) was about to make more free land to order.

"With characteristic American speed, four projects were authorized within a year after the passage of the act, seven more the following year, and nine the year after—so that, within three years, work was under way on twenty projects, involving an expenditure of $150,000,000. This gigantic enterprise was undertaken with no previous experience to guide the government. The work was regarded as chiefly an engineering enterprise, and no doubts were entertained regarding the skill of American engineers. This confidence was justified, for the immense dams of concrete that impound the irrigation waters of these projects are among the most monumental of the works of man, and promise to endure as the pyramids, and to the greater glory of their creators.

"But (it soon became apparent) engineering was the least of the problems involved in reclamation. The physical works were only magnified examples of the application of known formulas and practices. The reclamation idea assumed that an equally simple formula could be applied to the settlement and development of the projects. This formula was, that 'land *plus* water *plus* settlers *equals* a successful reclamation project.' This formula—so time has proved—is not correct. It can be made correct only by adding numerous qualifying adjectives to the nouns—thus:

" 'Good land, cleared, leveled, broken up, artificially drained, and planted to the right crops, *plus* water *plus* settlers with adequate capital, previous practical farming experience, high character, good brains, exceptional energy, and a knack for co-operation with their neighbors *equals* a successful reclamation project.'

"Twenty-three years of experience with reclamation has taught the Federal Government how rarely this combination of elements can be got together. Only three of the twenty-seven projects now completed are satisfactorily successful in all respects.

"The rosy side of the reclamation picture can be briefly painted, as it is in a government report, as follows: 'The twenty-five irrigation projects, the development of which has advanced to the stage of *producing crops*, comprise some 34,000 farms and a cropped area of approximately 1,175,000 acres, and produce annually crops having a gross value of more than $50,000,000. This is practically equivalent to the agricultural situation in the State of Massachusetts'—both as to number of farms and as to value of crops. The reclamation enterprise may truthfully be said, therefore, to have 'added another state to the Union.' "

"THE darker side of the reclamation picture is more extensive," says the writer, and he goes on to enumerate the unexpected problems which have proved so troublesome on the reclamation projects, and with which most irrigationists have become only too familiar.

The first cloud on the projects was the unduly optimistic publicity broadcasted regarding the project lands. It was wrongly assumed by the whole country, says Mr. Strother, that all the land on all the projects was first class land, ready for the plow and the seed. When disillusionment came, with results well known to irrigationists, the result was "that many settlers were defeated before they started, and have ever since nursed a natural resentment against the government for what they feel was a fraudulent misrepresentation of the lands they bought."

THE need for drainage, the price of land, which, with construction costs added, was much more expensive than had been believed by the settlers that had rushed to take it; the erroneous impression that all the project land was government land, when much of it was not; all these added to the grief of the service and the troubles of the settlers.

"The settlers early came to Congress with their troubles. The Reclamation Act, as originally passed, provided that every settler should pay his share of the construction cost of the irrigation works in ten annual installments. For the reasons given above, thousands of the settlers had spent more than they had expected to spend, and had no money to pay the installments. So general was this situation, and so numerous were the just claims of settlers to consideration, that Congress doubled the period of payment, extending it to twenty years. This, the so-called Extension Act, was passed in 1914. It was more than an extension agreement—it was a refunding operation as well. Settlers not only got more time to pay their per-acre share of the cost of the permanent irrigation works, but they were allowed to add their arrears on the yearly charges for water-service to this capital account, spreading the whole over a long period and without any interest charges.

"This was the first of the 'relief' measures for the benefit of the settlers. Twice since that time, Congress has been appealed to for further relief, and granted it—in 1922 and 1923—in the form of acts permitting the Secretary of the Interior to defer collection of payments then due.

"The theory of abstract justice underlying these leniency measures was that the government had made a mistake in its original plan of payment, when it assumed that all settlers could pay out in the same number of years. This assumption presupposed another, name-

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ly, that all the lands they bought were equally good—which, of course, was not true. To that extent, and for a good many other reasons suggested above, justice favored the settlers as a whole.

"RECENT investigation, however, has shown that justice cannot be administered wholesale. Some settlers on some projects have kept up their payments punctually, through good seasons and bad, and often at severe sacrifice of comfort and future prospects. On the other hand, other settlers on the same projects, with better land and more financial resources, have purposely let their payments go by, trusting to just such blanket 'relief' from a tender Congress to give them years longer to pay. . . . . .

"The 'leniency laws' offered no permanent solution of these complex problems. They simply postponed them. Demands for further 'relief' being pressing, the Secretary of the Interior, Dr. Work, two years ago appointed a Fact Finding Committee to investigate the whole reclamation situation and to recommend a permanent solution. In April, 1924, the committee reported. Congress enacted some of its recommendations. Recognizing that wholesale relief was inequitable, Congress authorized the Secretary of the Interior to decide each individual case on its merits, to extend the time of payment where justice required, and to demand immediate payment where the settler was able to pay.

"Then the trouble began. In the spring of 1925, Director Mead, with the backing of the Secretary, 'notified settlers that hereafter relief, when extended, would be to individuals; and to them only after a showing that the delinquency was due to obstacles they were unable to overcome. That notice has caused the bureau to lead a strenuous life. Applications for individual relief came in this year by the thousands. They had to be examined and reported on in the field, and then scrutinized in the Washington office. . . ,

"The uproar attendant upon this unfamiliar process of collecting money due the government filled the newspapers of the country last spring and summer with the anguished cries of Western settlers and Western Senators. Demands were made that President Coolidge should dismiss Secretary Work from his Cabinet, and other violent gestures of protest were numerous. The issue is now up to Congress, and much oratory, some execration, and probably further 'relief' will be the result."

ALL THIS that Mr. Strother recites, so far as it is a matter of record, is familiar to readers of MODERN IRRIGATION, but to see a magazine of the type of WORLD'S WORK taking up the reclamation problem for discussion as a leading national issue is encouraging to those who are interested in rehabilitating and extending reclamation activities in general. As Mr. Strother points out, there are lessons implicit in the reclamation situation more important than the persons and funds directly involved:

"In itself, it is a matter of the trials of perhaps 200,000 citizens among 100,000,000—the concerns of two tenths of 1 per cent of the population of the country. It is likewise a matter of perhaps $200,000,000 of government money, which sooner or later, and more or less, is to be returned to the Treasury—an item of small moment by comparison with many others. But, viewed as an experiment in government, how important the issues involved!"

Among the lessons which the experience of federal reclamation teaches, the writer finds, are: that the government should go slow in committing itself to new projects; that the states in which projects are located ought to be compelled to take over the financial burden and the administrative control of their own projects; that, by some means, land speculation must be eliminated; that levelling and draining project lands are as essential as constructing irrigation works; that settlers must be carefully selected and lands properly classified. In many of these conclusions Mr. Strother is in accord with the practically unanimous opinion of all students of the situation; in a few of them he will be questioned by those who can not find justification for the conclusion in the premises.

Summarizing the whole situation the writer declares: "The only way permanently to correct the mistake is to change the whole underlying basis of the operation. The government can lend its credit to the states for these operations; the government can supply engineering skill and agricultural advice; but it cannot supply individual credit or local business management. It is folly to try. The states must assume these burdens."

How One Texas District Is Leading in Reconstruction

(Continued from Page 17)

long, which carry the water up through control gates to the main canal and settling basin. The tubes pass under the track of the Missouri Pacific Railway. Two contraction and expansion joints will be provided.

AT THE lower end of the settling basin, two miles from the pumping plant, the main headgates will be located. For six miles from the pumping plant the canal is located in a normal cutting of about four feet. The present construction calls for a canal twenty feet wide on the bottom, two to one side slopes, eight feet height of levee, and six-foot width of crown. On the lower or south side of the canal the levee will be placed outward sixteen feet, leaving a berm of that width. The grade of this section will be nine inches in 5,000 feet, giving for a seven-foot water depth a velocity of two feet per second, and a discharge of 480 second feet. This berm removed, the grade lowered one foot, and the material used to raise the levee one foot, a canal with capacity to serve all the second bench land in the valley will be produced.

About four and one-half miles from the main head works the canal enters deeper cutting, this varying from four to eighteen feet. There is about four and one-half miles of this section, the grade of which is one in 5,000. The

last section is two miles in length, the bottom grade of which is level. Hydraulic gradient is obtained by a change of the water depth, the depth in the Penitas main being seven feet, and that in the North main of the distribution system five feet. The cross-section of the canal in this section conforms to the required capacity and grade.

The canals of District No. 4 distribution system are designed and constructed using uniform cross-sections and grade. The side slopes are everywhere two horizontal to one vertical. The grade of the North main canal is one in 5,000, and that of the East main one and one-half in 5,000. The grade of the laterals ranges from one to two in 5,000. The area of the district is laid out in four sections of nearly equal area, and a canal is constructed with full capacity to each of these sections. The system is planned for a twenty-day rotation, five days being allowed for delivery to each section. The main laterals are built with a capacity of one second foot for each thirty acres served.

THE STRUCTURES in the main canals and main laterals are built of re-inforced concrete, the aggregate used being in the proportion of one-two-four. The steel used is cold square twisted. The outlet gates from main canals and main laterals are constructed of re-inforced concrete, but the farm outlets from laterals are constructed of creosoted lumber, 12 pounds of creosote per cubic foot of lumber. A farm outlet is provided by the district to each forty-acre tract, this outlet being located on the commanding ground for that tract. Steel outlet gates are being used in all outlets from main canals and main laterals. As far as is possible all structures have been standardized.

Provision for the disposal of seepage and excess rainfall is being made by connecting borrow pits to low points, and there installing crude oil engines directly connected to horizontal centrifugal pumps and pumping the water into the canal for use below.

Along the canals at intervals of about one mile gauging stations have been installed for the measurement of the discharge. These gaugings will locate points of large seepage, rendering it possible to repair weak places and prevent excessive losses.

Arrangements are being made to install meters at all farm outlets, and the system placed upon a metering basis. This will reduce waste, excessive use, seepage and the water-logging of thousands of acres of land, and will prove a saving to the individual farmer and to the district as a whole.

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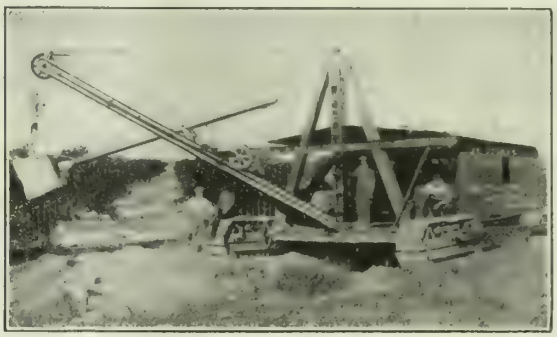

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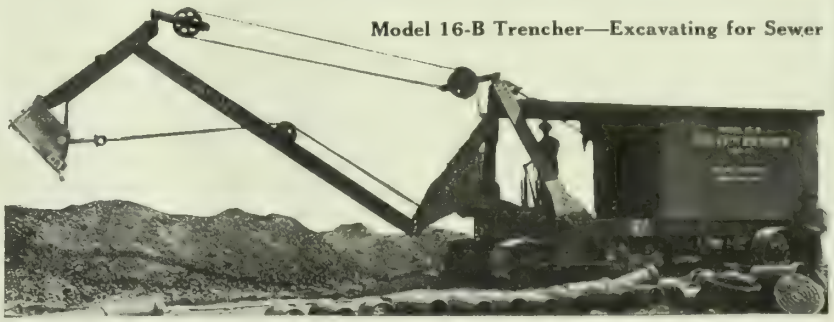

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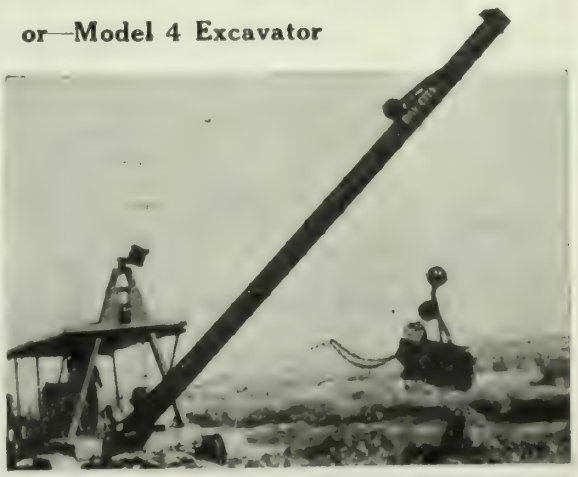

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IRRIGATION FINANCE

WHEN THE STATE GUARANTEES THE INTEREST

By RHEA LUPER

State Engineer of Oregon

OREGON'S irrigation district law, in its present form, was enacted in 1917, and the constitutional amendment providing for the State guarantee of interest for the first five years on irrigation or drainage district bonds was passed by the people on June 3, 1919. These two laws, the constitutional amendment and the irrigation district code, form the basis upon which irrigation development in Oregon has proceeded thus far.

During the past eight years Oregon has built, under the irrigation district plan, twenty-three projects. Within these projects, when organized, there were 49,400 acres of irrigable land, and today that area has been increased to 120,500 acres, leaving more than 100,000 acres yet to be irrigated.

Under the terms of the law, any irrigation district may borrow money if it can, and may sell its bonds without first obtaining the consent of the State Securities Commission. There is no legal prohibition, but the provision allowing the certification of a certain class of bonds was placed in the law, and now no district can hope to find a market for bonds which have not been certified; therefore, primarily the law had the effect of dividing irrigation districts into two classes, those which were speculative and those which were not.

SPECULATIVE projects were those which we ordinarily term raw projects and which were dependent entirely on values to be created by the construction of the project. They could not meet the requirements of certification.

In the other class are those projects having established values in their lands, not dependent upon the construction of the works entirely for the creation of such values. They were largely colonized and the lands were either being dry-farmed or they included lands which were improved and irrigated, but had an insufficient water supply.

The law provides that before the bonds may be certified the commission must make an investigation and find that the irrigation system is feasible and that the aggregate amount of bonds under consideration, and any other outstanding bonds of said district, does not exceed fifty per cent of the aggregate market value of the lands within the district, and of the water rights and all irrigation works owned or to be acquired or constructed with the proceeds of said bonds.

UNDER the law's application it is evidently intended that a project, to meet the requirements of certification, must not only be feasible, but must have values when completed more than double the amount of its indebtedness. With conservative appraisals it would seem that there could be no loss either to the creditors, to the State, or to the settlers. Where the law has been strictly applied, where appraisals have been conservative, there will be no loss. But on those projects where appraisals were based on inflated values, where the indebtedness created was the maximum allowed under the law, and where, added to that, the districts were loaned additional money by the State with which to pay interest on their bonds, we will have trouble.

Two of Oregon's largest districts are in default on their bonds, and several of the small ones are making no progress. The Slide Irrigation District, on the bench across from Weiser, has a $100,000 pumping plant which was idle this season.

The Warmsprings Irrigation District, containing 27,000 acres of irrigable land, is marking time waiting for action by the Reclamation Service which will give it some relief, but it is in such a condition that no progress in settlement or colonization of its lands can likely be made until there has been a re-adjustment.

The Ocohoco District contains something over 17,000 acres of irrigable land and it, too, is in a very uncertain condition. The settlers feel dazed and do not know which way to turn.

The Silver Lake District was constructed in 1918, yet the area in cultivation and the population of the district has not increased. It is also in default.

I have mentioned these districts by name because I do not wish my remarks to be construed as applying to other successful districts. I do wish to show, however, that after confidence has once been lost it is almost impossible to re-establish it.

The bond underwriters insisted that irrigation district bonds must be general obligations of the entire district. Perhaps they are right, but it seems to me that the general obligation has been a two-edged sword, for when confidence in the success of the district begins to wane it is the thing that causes the settler to lose his credit, regardless of the value of his holdings within the district.

UNDER the law the bonds must be paid from taxes levied by the board of directors of the district as other taxes are levied and collected, and it is mandatory perhaps that the board levy sufficient taxes to meet the estimated expenses of the district. But it is one thing to levy the tax and another to collect it.

The bondholder does not hold a mortgage in the sense we understand on the lands in the district that can be foreclosed. He cannot take possession of the entire area except that indirectly he may, by paying the taxes on particular tracts, secure a tax certificate which may be foreclosed. In that manner he can acquirely title ultimately to those tracts on which taxes have not been paid; but that is a long and tedious process, and before it could be completed the system might fall to decay and the entire project be abandoned. It is not a practical way for the bondholders to be paid.

It is true that he has other recourse, but that also seems impracticable. He may take possession of the irrigation system and have it operated through a re-

ceiver appointed by the court. The law does not define the duties of a receiver in this particular instance. Under those circumstances, it is doubtful if a receiver could get the support of the community. With the projects only partially settled there would be no possible source of revenue from which sufficient funds could be obtained to satisfy the district's creditors, unless he were authorized to treat with each settler individually, and he is not so authorized under the statute. He could not hope to induce any settlers to come on the project and the condition would be worse than it is at the present time.

The law does not contemplate failures, and does not provide a way of meeting such a contingency, and therefore I feel that there is now no law in the state under which we can be assured that our unsuccessful projects can be reorganized.

Niland Bonds Sold

A bond issue of $140,000, voted by the Niland (California) Water District early in December, has been sold at par to Freeman, Smith & Camp, of San Francisco; and R. E. Campbell Company of Los Angeles. Although the acreage covered by the bond issue is within the Imperial Irrigation District, its development is under the Niland Water District because the irrigation district's funds for new construction are exhausted.

Citizens Take Over System

Ten citizens of Pismo Beach have purchased the water system of the community as the climax to protracted litigation directed at improving the quality of service rendered and will operate it with the idea of insuring efficient and inexpensive service, they have announced. The appraised value of the system is $23,000.

Bonds Bring Record Sum

The best price ever obtained for Nampa & Meridian bonds was received when the Nampa (Idaho) State Bank recently purchased $48,500 worth of the district's issue at par and accrued interest.

A Dissenting Interpretation

(Continued from Page 22)

laterals, making it difficult to deliver water as required; and increased flood menace, due to lack of continued experienced investigations and study. It also resulted in the district's having more than $250,000 of registered warrants, with a certainty of more than twice this amount before the first of 1926 unless 1926 taxes are used for 1925 operations. It has, of course, also improved the political organization favored by the majority directors.

All this plainly shows the detrimental effects of the efforts of four directors who are attempting to manage without adequate assistance the details of maintenance, operations, improvements and protection of a project of great magnitude. They must do this, also, in time taken from their regular business, as their compensation is fixed by law at $150 per month.

Unless a radical change is made in the policy, by centralizing authority in trained and experienced hands, I fear that the morale of the district's employees will become very low, and the physical condition of the river control and canal system will deteriorate; and considerable time, with large expenditure of money, will be required to re-establish conditions as they were before.

Preparatory Work Rushed as Kittitas Contract Signed

Preparatory work for the construction of the Kittitas division of the Yakima project in the State of Washington is being rapidly pushed by the Interior Department, following the execution of the contract between the State of Washington and the federal government under which the state assumes responsibility for settlement.

The Bureau of Reclamation has authorized its local representatives to secure at the earliest possible moment the necessary right of ways for canals, laterals, and other irrigation works. According to the plan adopted, these right of ways will be secured through the Kittitas Reclamation District organization and the title subsequently transferred to the United States. Other agreements now being negotiated by the Reclamation Bureau are purchasing of flowage rights above the proposed diversion dam and contracts for building irrigation structures across the tracks of the Northern Pacific Railroad.

Elwood Mead, Commissioner of Reclamation, has also announced that engineers will soon be transferred to duty either from the Denver office of the Bureau or other projects to take charge of the actual construction work on the Kittitas project. An appraisal board already on the division has commenced the appraisal of the lands to be purchased by the Government.

Construction on the Kittitas division of the Yakima project was ordered in December by the Secretary of the Interior after the State of Washington had executed a contract to assume the cost of the settlement and development.

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The Mokelumne River Project

(*Continued from Page 15*)

pacity of 30,000 horse power. The water from this power development is all returned to the river and therefore it does not interfere materially with irrigation uses, but has a regulating effect that is beneficial.

There are two other small ditches which divert water from tributaries of the North Fork for mining purposes. These are known as the Jackson and Volcano ditches and have capacities of 20 and 35 cubic-feet per second, respectively. They have largely fallen into disuse.

The Clark ditch diverts a small amount of water from the upper portion of the South Fork for mining purposes, but has not been in service recently. Further down, the Mokelumne ditch diverts a small quantity of water from the South Fork, which is carried to the town of Mokelumne Hill and territory to the southwest, terminating near the town of Wallace. The portion below the town of Mokelumne Hill has been abandoned and the upper portion is used only to a small capacity.

A PRIVATELY owned reservoir site, known as Railroad Flat, has been surveyed and a little construction work done on the foundation of a dam located just below the junction of the Licking Fork with the South Fork about two miles north of the town of Railroad Flat. The project proposing to use this reservoir site involves the construction of a small reservoir on the Middle Fork about two miles northeast of the Railroad Flat Reservoir and the diversion of the storage of the small reservoir by means of a canal and small tunnel into a branch of Licking Fork, whence it will run into the reservoir above described near Railroad Flat. The ultimate feasible capacity of this reservoir with a dam about 325 feet high is said to be in the neighborhood of 60,000 acre-feet, exclusive of the small proposed reservoir on Middle Fork.

The Mokelumne water-shed is distinctly a mountain source of supply, the total drainage area and the elevation of the several parts thereof, being as follows:

Above Lancha Plana Reservoir	568 sq. mi.
Above 2,000 ft. elevation	527 sq. mi.
Above 3,000 ft. elevation	478 sq. mi.
Above 4,000 ft. elevation	409 sq. mi.
Above 5,000 ft. elevation	320 sq. mi.
Above 6,000 ft. elevation	235 sq. mi.
Above 7,000 ft. elevation	174 sq. mi.
Above 8,000 ft. elevation	87 sq. mi.
Above 9,000 ft. elevation	8 sq. mi.

The upper part of the drainage basin is about timber line and is largely of rock, which is either bare or sparsely covered with soil, upon which some grass and alpine shrubs occur. Farther down, forests begin and over two-thirds of the basin is in Forest Reserves.

Agriculture has never gotten a start in this region and the possibility of any considerable development is very remote. The mining industry was important at one time in this basin, but there is now no mining activity.

Practically nothing is being done with the splendid body of timber which stands on the land within this basin. When cutting begins, it would be under the supervision of the United States Forest Service, so far as it is on public land.

The stock raising industry is confined mainly to summer pasturage upon the Forest Reserves, which is strictly limited in amount and becomes negligible in winter.

The only other industry in this basin is the hydro-electric operations of the Pacific Gas and Electric Company, which have been mentioned.

The Mokelumne Basin contains no swamp or marshy areas or other tendency to discoloration of the water and it is distinctly not a sediment producing basin. The water ranks high along with other Sierra sources as pure and soft, and if any treatment is required, it will be slight and inexpensive. Such organic pollutions as creep into the water from this mountain area will be held in storage in a large reservoir which will have a gross capacity of over 200,000 acre-feet.

THE MOKELUMNE project, as adapted to the needs of the East Bay Municipal Utility District, proposes a dam across the Mokelumne River at a point about five miles nearly due north of Valley Springs and about four miles northeast of the old mining camp of Lancha Plana. This dam would be built to a height of about 350 feet above its foundation and raise the water surface to 562 feet above sea level, forming a gross storage capacity of 222,000 acre-feet. It is proposed to draw these waters through a tunnel at elevation about 400 feet above sea level, above which would be an available storage capacity of about 198,000 acre-feet.

Two gaps occur in the perimeter of the basin, one on the north side of the river and one on the south side, both lower than the proposed flow line of the reservoir. The gap on the south side is slightly lower than the one on the north, and discharges its water into Spanish

(*Concluded on Page 48*)

A Many Million Dollared Market

THE REPUBLIC of Mexico will expend $30,000,000 on reclamation projects. As told elsewhere in this issue, an American engineering firm has been placed in charge of this undertaking.

Since America (the United States) leads in the manufacture of the most modern irrigation appliances, and auxiliary equipment of every description, it goes without saying that aside from labor costs the major percentage of these 30 millions will be spent within the boundaries of the United States.

American-made drag-lines, dredges, and other excavating machinery; trucks, tractors and automobiles; cement, cement re-inforcing and other materials; pipe and pipe fittings; gates and valves; motors and motor controls; meters and other odds and ends that go to make up a fully equipped irrigation project—these will have to be provided for, and the United States is the logical source of supply.

The advertising columns of MODERN IRRIGATION are the logical source of current information regarding such equipment. Engineers and other executives, who do ordering or specifying, will find these columns during 1926 a reliable "Who's Who" of manufacturers selling the hydraulic field. Here the leading, most progressive concerns in every line will be represented.

At this moment, the pages of MODERN IRRIGATION are being examined, and examined carefully, by men whose yearly purchases in *your* line aggregate large sums of money. Long-pull advertising will help you to secure a larger percentage of this annual turn-over. The men who buy are reading and studying these advertisements—never doubt it. Consciously, or unconsciously, they are forming their opinions and narrowing down their ultimate choice of equipment. Many actual decisions are made months in advance of the order for the goods. None but the most backward companies in business today are not fully alive to this, while those of seasoned advertising experience are now, as never before, bringing up their advertising artillery for the big year's business ahead.

Mexico's reclamation project is but one of the countless many under contemplation—or actual construction—at this time. Nineteen-twenty-six will be a great year in the irrigation and allied hydraulic industries. Millions will be spent for replacements and other millions for new equipment. Are YOU making your proper bid for a share of this business? Are you represented, as an advertiser, in the columns of MODERN IRRIGATION?

If not, phone, wire or write immediately for rates and complete information. Just say: "We wish to sell more equipment this year to the hydraulic field. How can MODERN IRRIGATION help us do it? Rush full particulars."

For Detailed Listings, Branch Offices, Etc., See the Buyers' Guide to Leading Supply Sources—Pages 55-56

OVERHEAD IRRIGATION

WHAT IS YOUR EXPERIENCE?—*AN EDITORIAL*

OVERHEAD irrigation is admittedly a subject of great interest among a large group of irrigators, especially that considerable proportion of the agriculturists of the southwest who raise such crops as oranges, lemons, grapefruit, avocadoes and other fruits that require meticulous cultural care and yield proportionately lucrative returns.

At the time of the establishment of this magazine, the subject was considered of sufficient interest to justify the establishment of a special department to be devoted to the presentation of material of specific interest to those who are using overhead sprinkler equipment in irrigation, or who are considering the possibility of installing such equipment. It was planned that, under this heading, there should be offered the experiences of overhead users, the studies of investigators who were concerned with overhead sprinkling from a scientific aspect, and the contributions of irrigationists who have a specialized knowledge on the use of sprinklers and who are willing to share this knowledge for the benefit of others.

THIS department was not established as a means of propaganda, with the object of selling "overhead" to the irrigation industry. The editors have no axe to grind in this or any other department of the magazine.

If there are irrigators who have given overhead equipment a thorough and adequate trial, and have been convinced that its principle is not adapted to the solution of the particular problems with which they must deal, and that their failure has not been due to collateral factors such as improperly planned equipment, neglected tillage, or any other element in the culture of the crop than the principle of overhead irrigation applied in its most efficient form, those experiences are valuable, and as much a part of the literature on the subject as the story of its successes.

On the other hand, irrigators who have tried out this method of supplying artificially the moisture needed by the growing crop and have found that it succeeds, have an opportunity to help other irrigators, if they will, by telling of the particular principles and practices which they have proved to be effective.

CONTRIBUTORS who have discussed, under this heading, various aspects of overhead practice have emphasized, already, a difficulty early encountered by the editor. That is, that overhead is such a new thing, relatively speaking, that there is a very meagre body of scientific knowledge on the subject. Many advantages are claimed for it by its advocates, but, as pointed out, these enthusiasts are not always in agreement as to the advantages claimed. The man who is most convincing in upholding the superior control of soil moisture which the sprinklers afford, scornfully repudiates the idea that it has any marked effect on the quality of the fruit. The advocate who points jubilantly to the improved quality of fruit possible under "the gentle rain from heaven" that overhead affords, may believe there is little, if any, justification for the assertion that it aids in frost protection. The grower who has found that turning on the sprinklers will hold up the temperature when his neighbors are lighting the smudge-pots, may be inclined to doubt the claims that it will resist wind damage. And the man who has found it most effective in minimizing the injuries wrought by hot, dry winds, possibly considers that it is negligible as a better method of controlling soil moisture than the customary furrow system with which it competes.

Some, of course, have found that overhead lives up to its most optimistic claims in two, or three, or more of these ways; and others collate the testimonials of all of the above and conclude that the advantages claimed in each case have been clearly demonstrated, meanwhile discounting the doubts reflected by the less enthusiastic. Among the more scientific investigators there is likewise marked difference in the importance attached to the various claims. One eminent student of agriculture in Southern California not long ago expressed the conviction that in ten years every citrus grower in the state will be using overhead equipment. The same day another authority, head of a state university department which deals with just such questions, in a conversation with the present writer, pooh-poohed such an assertion and expressed his doubt as to whether anyone could say that overhead systems would still be in use after that period of time.

BUT, in spite of the fact that overhead irrigation is relatively new, those who are daily using it have their own convictions, which are probably better founded than that of any office observer, as to its advantages, its adaptability to various conditions, and its future. MODERN IRRIGATION invites these users to write to this department and tell what they have learned of overhead and its use. You, who have installed overhead equipment and are using it in the growing of crops, will you not contribute for the benefit of others the results of your experience?

We want your personal, informal letters, telling what you think of overhead, but, more especially, why you think as you do. These letters will be published in forthcoming issues of the magazine.

If you have recently installed an overhead system, a description of its principal features, a statement of costs, a sketch of the plan showing the size of pipe used in its different elements, and a discussion of the cultural problems that induced you to decide to install overhead equipment would be very helpful to the readers of this department.

If you have been for some time a user of overhead, summarize the lessons which you have learned about its operation and usefulness, and give the results attained in the current year—what superiorities, (or lack of them) it has manifested, and how your crops compares in quality and quantity with that of your neighbors who do not have overhead.

We make complete installation if desired

This new Sprinkler will practically last a lifetime. We guarantee it unconditionally for five years.

Oil or grease cup in which adjustable hardened cone thrust bearing operates.

A *New Type* Campbell

Overhead Irrigation Sprinkler

THIS IS THE SPRINKLER YOU HAVE BEEN WAITING FOR — IS PERFECTLY BALANCED, HAS LONG UPPER AND LOWER BEARINGS, LUBRICATED HARDENED CONE THRUST, FELT STRAINERS TO KEEP SAND OUT OF BEARINGS AND MANY OTHER NEW FEATURES.

J. P. CAMPBELL IRRIGATION CO.

SUITE 240 WILCOX BLDG. LOS ANGELES, CALIF.

For Detailed Listings, Branch Offices, Etc., See the Buyers' Guide to Leading Supply Sources—Pages 55-56

A TYPICAL LACY "JOB" IN THE IRRIGATION COUNTRY

Lacy Manufacturing Co.

Manufacturers of

Riveted Steel Pipe From 4 Inches to 10 Feet in Diameter

Originators *of Rust Proof Covering for Metal Pipe*

STEEL TANKS OF ANY CAPACITY

Works: Main and Date Sts.
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Main Offices:
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Roscoe Moss Company
Well Contractors

We are completely equipped to drill wells of any desired size or depth. Our rigs operate throughout the Southwest. Headquarters for well supplies; rental tools.

4360 WORTH ST. Ph: ANgelus 7146 LOS ANGELES

Be definite, be practical, give figures, if possible let us have a photograph of your installation. Your story will not prove or disprove the merit of the overhead idea, but it will be interesting and helpful to those who may be facing the same problems that you are daily encountering.

NOT LONG ago a gentleman who is professionally interested in the problems of irrigated agriculture, and who is an authority on many aspects thereof, was talking with the editor. "I do not think," he said, "that some of your articles on overhead irrigation are worthy of a scientific journal." He was right; but there is no body of scientific knowledge on this subject available for use. He will not be satisfied, probably, that the letters from users of overhead equipment constitute a contribution to the literature of the subject from a scientific standpoint. But the best thing—the only thing—that we can do is to attempt to work this thing out together, by exchanging our experiences, limited and isolated as they may be, and by deriving mutual profit from the interchange of thoughts on the subject.

Meanwhile the magazine will be alert for contributions on the subject from men who can speak from broad observation, who can generalize from their contact with a multitude of overhead systems, who have learned its secrets, or are learning them, by laboratory and field experiments, and we will present the opinions of such contributors whenever they are available. But the individual farmer, whether he has two acres or a hundred under the sprinklers, has something that he can contribute, and his cooperation is respectfully requested.

Davis Describes Big Mokelumne River Project

(*Continued from Page 44*)

Springs Gulch, which will lead them back into the Mokelumne River about one-quarter of a mile below the dam site. It will be necessary to build an embankment across this gap about 20 feet high to secure the desired storage height in the reservoir.

The gap on the north side would discharge waters into Jackson Creek, whence they would flow into Dry Creek and be available for storage in any reservoir provided at or below that point.

A large reservoir site on Dry Creek is not available for development under present circumstances, because the flow of water in Dry Creek is so meager and uncertain that its storage would be expensive and results very small and precarious. The provision of a high dam

on the Mokelumne sufficient to throw all the surplus waters to the northward makes available about two-thirds of the flow of the Mokelumne River, or an average of over 500,000 acre-feet per annum. The provision of this high dam, therefore, without expense to the irrigation interests, is a great and positive benefit to irrigation development, and it is hoped that this contribution by the District will lead to the early development of the Mokelumne Basin with a completeness and economy not possible on most other streams in California.

Tacoma Plans Million Dollar Water Improvement Program

Main Unit Is Construction of Twenty-five Million Gallon Reservoir for the City

Tacoma, Washington, has a program of water improvement for 1926 that will involve the expenditure of a million dollars, for which six per cent serial bonds have been issued. Ira S. Davisson, commissioner of Light and Water, recently outlined the improvements planned under this program.

The principal development will be the construction of a reservoir of 25,000,000 gallon capacity. This reservoir will be constructed near the site of the present reservoir of the Tacoma Water Supply Company, and will have facilities to serve the entire North End of the city. The reservoir will match the approximate capacity of the entire city system now.

Adjacent to the new reservoir will be constructed a 1,000,000-gallon standpipe, with a pumping station capable of handling 10,000,000 gallons of water a day.

The money received from the sale of the bonds will also be used for the construction of a spillway from the reservoir to Puget Sound, through which surplus water can be wasted.

The second item in connection with the bond issue has to do with the acquisition of the Tacoma Water Supply Company, which now serves approximately 2,600 customers in the North End of Tacoma and in Ruston. It is now planned to acquire the system by purchase, but should a deal now pending fail to materialize, it is stipulated that condemnation proceedings be started.

Prosser Now Owns System

The city of Prosser, Washington, has purchased from the Pacific Light & Power Company the municipal water system for a consideration of $10,000.

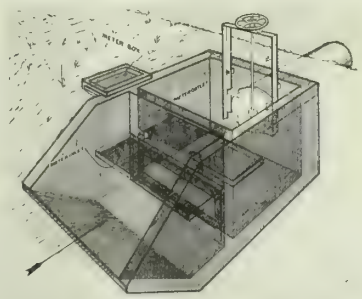
AMERICAN STEEL PIPE and TANK COMPANY

We Manufacture

Riveted Water Pipe
Galvanized Surface Irrigation Pipe
Well Casing made from Hard Red Steel
Galvanized Corrugated Tanks
Black Welded Tanks
Sheet and Plate Steel
products generally

American Steel Pipe and Tank Co.

814-15 W. M. Garland Bldg.
Los Angeles
Phones Metro. 0898 and Metro. 0899
Fresno Branch
2005 Broadway, near Divisadero

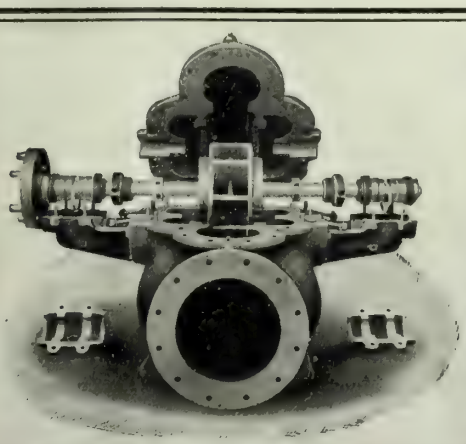


Submerged Orifice Measuring Structure

acre foot meter and turn out gate combined.

The installation cost of this unit is remarkably low. Write for design catalog.

GREAT WESTERN METER COMPANY
Oakland 1290 Powell Street California



PRICE PUMPS

We specialize in Centrifugal and Deep Well Turbine Pumps for Irrigation and Industrial Uses—
Our Double Suction Split Case Type illustrated herewith are carried in stock—
High in Efficiency.
Dependable in Performance.
And Low in Upkeep Costs.
Your inquiries are solicited.

G. W. Price Pump & Engine Co.
1350 Folsom St., San Francisco
Members Western Irrigation Equipment Assn.

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SURVEY *of* HYDRAULIC DEVELOPMENT

As Shown by Official Records of the Month -- Local, State, and Governmental

PERMITS AND APPLICATIONS SHOW INCREASING ACTIVITY

AMONG the more important permits to appropriate water issued by the Department of Public Works, Division of Water Rights of California, during the month of November, 1925, were the following:

Permit No. 2299, Application No. 4275 (San Joaquin County). Issued to Mrs. Annie Fabian, et al, Tracy, Calif., November 2, 1925, for 17.5 cubic feet per second from Old River in Section 3, T 2 S, R 4 E, M. D. M., for irrigation of 1422.3 acres near point of diversion. Estimated cost $15,000.

Permit No. 2300, Application No. 4276 (San Joaquin County). Issued to A. Grunauer, et al, Tracy, Calif., November 2, 1925, for 29.87 cubic feet per second from Old River in Section 3, T 2 S, R 4 E, M. D. M., for irrigation of 2514.8 acres near point of diversion. Estimated cost $25,000.

Permit No. 2301, Application No. 4500 (Riverside County). Issued to Luz S. Guirado, Whittier, Calif., November 3, 1925, for 0.27 cubic feet per second from an unnamed spring in Section 24, T 5 S, R 6 W, for domestic and irrigation of 60 acres near point of diversion. Estimated cost $1740.

Permit No. 2302, Application No. 4517 (Butte County). Issued to F. D. Popejoy and Jackson Mullings. Enterprise, Calif., November 3, 1925, for 1.25 cubic feet per second from Big Frey, Little Frey and Grubbs Creeks in Sections 30 and 31, T 21 N, R 7 E, M. D. M., Section 36, T 21 N, R 6 E, M. D. M., for domestic and irrigation of 100 acres near point of diversion. Estimated cost $1500.

Permit No. 2306, Application No. 4019 (Alpine County). Issued to Richard Heimsoth, et al, Woodfords, Calif., November 5, 1925, for 750 acre feet per annum from 3 unnamed gulches in Section 12, T 9 N, R 18 E, Section 1, T 9 N, R 18 E, Section 7, T 9 N, R 19 E, for irrigation of 929.6 acres near point of diversion.

Permit No. 2307, Application No. 992 (Modoc County). Issued to Royal A. Payne and Gertrude Payne French, Alturas, Calif., November 6, 1925, for 837 acre feet per annum from Flood and surplus waters of Fitzhugh Creek in Section 15, T 41 N, R 13 E, for irrigation of 251 acres near point of diversion.

Permit No. 2308, Application No. 993 (Modoc County). Issued to Royal A. Payne, Alturas, Calif., November 6, 1925, for 457 acre feet per anum from flood and surplus waters of Fitzhugh Creek in Section 23, T 41 N, R 13 E, for irrigation of 140 acres near point of diversion. Estimated cost $10,000.

Permit No. 2309, Application No. 994 (Modoc County). Issued to Gertrude Payne French, Alturas, Calif., November 6, 1925, for 157 acre feet per annum from flood and surplus water of Fitzhugh Creek in Section 23, T 41 N, R 13 E, for irrigation of 120 acres in Section 12. Estimated cost $1500.

Permit No. 2314, Application No. 4192 (Ventura County). Issued to Thomas O'Brien, Lebec, Calif., November 10, 1925, for 0.13 cubic feet per second from Sam Young Spring in Section 6, T 8 N, R 19 W, for domestic, stockwatering and irrigation of 151.24 acres in Section 6. Estimated cost $1700.

Permit No. 2324, Application No. 4537 (San Joaquin County). Issue to J. J. Hickey and Amuda Hickey, Stockton, Calif., November 17, 1925, for 2.75 cubic feet per second from Burns Cutoff in Section 12, T 1 N, R 5 E, for irrigation of 220 acres near point of diversion.

Permit No. 2325, Application No. 4018 (Eldorado County). Issued to Rose V. Jones, Vallejo, Calif., November 17, 1925, for 0.15 cubic feet per second from Little Iowa Creek in Section 33, T 11 N, R 12 E, for domestic use and irrigation of 138.6 acres near point of diversion.

Permit No. 2326, Application 92 (Butte County). Issued to Paradise Irrigation District, Paradise, Calif., November 18, 1925, for 4148 acre feet per annum from Little Butte Creek in Section 18, T 23 N, R 4 E, for irrigation of 11,100 acres in said district. Estimated cost $125,000.

Permit No. 2327, Application No. 2894 (Butte County). Issued to Paradise Irrigation District, Paradise, Calif., November 18, 1925, for 3000 acre feet per annum from West Branch of Feather River in Section 28, T 25 N, R 4 E, Section 18, T 23 N, R 4 E, Section 25, T 23 N, R 3 E and Section 19, T 24 N, R 4 E, for irrigation of 11,100 acres in said district. Estimated cost $325,000.

Permit No. 2328, Application No. 3437 (Butte County). Issued to Paradise Irrigation District, Paradise, Calif., November 18, 1925, for 50 cubic feet per second and 5000 acre feet per annum from West Branch of Feather River in Section 28, T 25 N, R 4 E, Section 18, T 23 N, R 4 E, Section 25, T 23 N, R 3 E, and Section 19, T 24 N, R 4 E, for irrigation of 11,100 acres in said district. Estimated cost $325,000.

Permit No. 2329, Application No. 3405 (Eldorado County). Issued to E. T. Larsen, Placerville, Calif., November 19, 1925, for 1.25 cubic feet per second and 60 acre feet per annum from Brush Canyon in Section 31, T 11 N, R 12 E, for domestic and irrigation of 100 acres in Section 35. Estimated cost $5,000.

Permit No. 2330, Application No. 4502 (Eldorado County). Issued to Phillip E. Hartwick, Camino, Calif., November 19, 1925, for 80 acre feet per annum from Brush Canyon in Section 32, T 11 N, R 12 E, for domestic and irrigation of 120 acres in Section 32. Estimated cost $2500.

Permit No. 2331, Application No. 4480 (Napa County). Issued to C. Skrable, Monticello, Calif., November 17, 1925, for 1.25 cubic feet per second from Putank Creek in Section 5, T 8 N, R 3 W, for irrigation of 100 acres near point of diversion. Estimated cost $4000.

Permit No. 2335, Application No. 4487 (Humboldt County). Issued to Peacock Mining Company, Oakland, Calif., November 24, 1925, for 16 cubic feet per second from Camp Creek in Section 23, T 11 N, R 5 E, for power purposes in Section 23. 96 T. H. P. to be developed. Estimated cost $3600.

Applications Filed

Among the applications for permit to appropriate water filed with the State Department of Public Works, Division of Water Rights, (California) during the month of November were the following:

Application No. 4824 (Shasta County) Red River Lumber Co., Westwood, Calif., for 10 cubic feet per second from Hat Creek tributary to Pit River to be diverted in Section 28, T 33 N, R 5 E, M. D. M. for power purposes in N E ¼ S W ¼ Section 8, T 33 N, R 5 E, M.D.M. 676 T. H. P. to be developed. Estimated cost $630,000.

Application No. 4825 (Los Angeles County) San Gabriel Water Co., care J. B. Lippincott, 543 Petroleum Sec. Bldg., Los Angeles, Calif., for 6 cubic feet per second from San Gabriel River tributary to Pacific Ocean to be diverted in Section 13, T 1 N, R 10 W, S. B. M. for municipal purposes in San Marino, portions of Pasadena, San Gabriel, Roseweed, Lamanda Park.

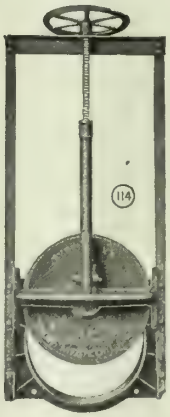
Application No. 4827 (San Diego County) Webster N. Kenyon, Box 22, Westmoreland, Calif., for 2 cubic feet per second from White Mountain Creek tributary to San Felipe Creek to be diverted in Section 11, T 13 S, R 8 E, S. B. M. for agricultural and domestic purposes on 160 acres. Estimated cost $4000.

Application No. 4828 (San Diego County) Webster N. Kenyon, Box 22, Westmoreland, Calif., for 3.5 cubic feet per second from Holly Creek (Underground Water tributary, San Felipe Watershed to be diverted in Section 13, T 13 S, R 8 E, S. B. M. for agricultural and domestic purposes on 280 acres.

Application No. 4830 (Tulare County) Myers Land Co., 6329 Pasadena Avenue, Los Angeles, Calif., for 0.05 cubic foot per second from Unnamed Springs (47) tributary to Capenero Creek to be diverted in Sections 4, 8 and 9, T 24 S, R 31 E, M. D. M. for domestic purposes in Sections 4 and 5, T 24 S, R 31 E, and Sections 32 and 33, T 23 S, R 31 E, M. D. M. Estimated cost $2000.

Application No. 4832 (Mendocino County) Agnes C. Thomas, care of Cunningham and Thomas, Ukiah, Calif., for 0.99 cubic foot per second from Russian River tributary to Pacific Ocean to be diverted in Section 16 T 15 N, R 12 W, M. D. M. for agricultural

·SNOW·
IRRIGATION APPLIANCES



SNOW STANDARD HEAD GATE, a heavy duty gate, rigid, substantial, extra strong, is adapted for use in all kinds of pipe, flumes, reservoirs, etc.

The gate and gate frame proper are of cast semi-steel; the frame extension is of structural steel, this extension and the screw can be furnished in any desired length to conform to the height of the wall.

The Standard Head Gate is made with either round or square openings and with either iron seat or brass seat in sizes six inch to forty-eight inch.

The non-rising steel screw with Acme machine cut threads operates through a bronze nut in the yoke; pressure from this yoke is exerted on the center of the gate lid, thereby giving an equal bearing around the entire circumference as the lid slides into place on the wedge shaped seat. Both lid and seat are accurately machined, making unnecessary the use of packing or gasket.

THE WEDGE SEAT

Easy to install and easy to operate, closing positively, accurately and water tight, without dragging on the seat.

A rising screw can be furnished, if preferred.

CONCRETE MACHINERY & SUPPLY COMPANY

EXCLUSIVE DISTRIBUTOR

2014 Santa Fe Avenue -:- Los Angeles, Calif.

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purposes on 79.24 acres in Sections 16 and 21, T 15 N, R 12 W, M. D. M.

Application No. 4834 (Plumas and Butte Counties) Oroville Wyandotte Irrigation District, care of R. A. Leonard, Atty., First Nat'l. Bank Bldg., Oroville, Calif., for 2,080 cubic feet per second and 300,262 acre feet per annum from South Fork Feather, Lost Creek, Dry Creek, New York Flat Creek tributary to Middle Fork Feather River to be diverted in Section 31, T 22 N, R 9 E, Section 21, T 21 N, R 8 E, Section 24, T 20 N, R 7 E Section 18, T 19 N, R 7 E, Section 1, T 20 N, R 8 E, Section 26, T 19 N, R 6 E, Section 20, T 20 N, R 8 E, Section 25, T 19 N, R 6 E, M. D. M., for power purposes. 75,028 T. H. P. to be developed. Estimated cost $4,000,000.

Application No. 4835 (Placer County) Fred Dewhirst, care of Emerson Hoar Co., 995 Market St., San Francisco, Calif., for 300 cubic feet per second, 100,000 acre feet per annum from Bear River tributary to Feather River to be diverted in Section 2, T 13 N, R 8 E, M. D. M. for power (Hydro-electric) purposes. 33,000 T. H. P. to be developed.

Application No. 4838 (Riverside County) James Kincheloe, Star Route, Corona, Calif., for 3.06 cubic feet per second from Bedford Canyon tributary to Temescal, Wash., to be diverted in Section 25, T 4 S, R 7 W, S. B. M., for agricultural and domestic purposes on 245 A in Sections 19, 20 and 30, T 4 S, R 6 W, S. B. M. Estimated cost $18,000.

Application No. 4840 (Los Angeles County) City of Long Beach Water Department, 607 City Hall, Long Beach, Calif., for 70 cubic feet per second and 65,000 acre feet per annum from San Gabriel River tributary to Pacific Ocean to be diverted in Section 13, T 1 N, R 10 W, S. B. M., for municipal purposes to supply city of Long Beach.

Application No. 4841 (Yolo County). Mrs. P. J. Brown, Grafton, Calif., for 7.45 cubic feet per second from Sacramento River tributary to Suisun Bay. To be diverted in Section 32, T 10 N, R 3 E, M. D. M., for agricultural purposes on 298 acres Section 32, T 10 N, R 3 E, M. D. M.

Application No. 4842 (Santa Cruz County). Forest Lakes Mutual Water Company, care of Geo. H. Hoyt, Secretary, Berkeley Bank Bldg., Berkeley, Calif., for 0.6 cubic foot per second and 100 acre feet per annum from Gold Gulch tributary to San Lorenzo River to be diverted in Section 27 (projected) T 10 S, R 2 W, M. D. M., for domestic purposes in projected Sections 27 and 28, T 10 S, R 2 W, M. D. M. Estimated cost $10,000.

Application No. 4843 (El Dorado County). Chas. F. Bradford, 2907 Fillmore street, San Francisco, Calif., for 75 cubic feet per second and 20,000 acre feet per annum from North Fork Cosumnes tributary to Cosumnes River to be diverted in Section 10, T 9 N, R 14 E, M. D. M., for power (hydro-electric) purposes in Section 35, T 10 N, R 13 E, M. D. M. 12,784 T. H. P. to be developed.

Application No. 4844 (Amador and El Dorado Counties). Chas. F. Bradford, 2907 Fillmore street, San Francisco, Calif., for 30,000 acre feet per annum from Middle Fork Cosumnes River, Sapidgo Creek, So. Fork South Fork Cosumnes tributary to Cosumnes River to be diverted in Section 9, T 8 N, R 14 E, M. D. M., Section 12, T 8 N, R 13 E, M. D. M. and Section 33, T 8 N, R 13 E, M. D. M. for power (hydro-electric) purposes in Section 6, T 7 N, R 13 E, M. D. M. 6,318 T. H. P. to be developed.

Application No. 4845 (El Dorado County). Chas. F. Bradford, 2907 Fillmore St., San Francisco, Calif., for 130 cubic feet per second and 36,500 acre feet per anum from Middle Fork Cosumnes River tributary to Cosumnes River to be diverted in Section 19, T 9 N, R 12 E, M. D. M. for power (hydro-electric) purposes in Section 19, T 9 N, R 11 E, M. D. M. 9,955 T. H. P. to be developed.

Application No. 4846 (El Dorado County). Chas. F. Bradford, 2907 Fillmore St., San Francisco, Calif., for 100 cubic feet per second and 20,000 acre feet per annum from North Fork Cosumnes River tributary to Cosumnes River to be diverted in Section 7, T 9 N, R 12 E, for power (hydro-electric) purposes in Section 19, T 9 N, R 11 E, M. D. M. 5,909 T. H. P. to be developed.

Application No. 4847 (San Mateo County). Peninsula Farms Co., Pescadero, Calif., for 1.5 cubic foot per second from Gazos Creek tributary to Pacific Ocean to be diverted in Section 1, T 9 S, R 5 W, M. D. M., for agricultural and domestic purposes on 250 acres. Estimated cost $20,000.

Application No. 4848 (San Mateo County). Peninsula Farms Co., Pescadero, Calif., for 2.67 cubic feet per second from Butano Creek tributary to Pacific Ocean to be diverted in Section 15, T 8 S, R 5 W, M. D. M., for agricultural and domestic purposes on 880 acres. Estimated cost $30,000.

Application No. 4849 (Mendocino County). E. L. Cunningham, care of Cunningham and Thomas, Ukiah, Calif., for 1.65 cubic feet per second from E. Fork Russian River tributary to Russian River to be diverted in Section 22, T 16 N, R 12 W, M. D. M., for agricultural and domestic purposes on 132 acres in Section 22, T 16 N, R 12 W, M. D. M.

Application No. 4850 (San Bernardino County). Alfred Violette 15 A Linden Ave., Long Beach, Calif., for 40,000 acre feet per annum from Antelope, Arrestre Creek and Rattlesnake Canyon tributary to Mohave Desert to be diverted in Section 2, T 1 N, R 5 E, S. B. M., Section 22, T 3 N, R 2 E, S. B. M., and Section 19, T 3 N, R 3 E, S. B. M., for agricultural and domestic purposes on 11,000 acres in Sections 30, 31 and 32, T 2 N, R 6 E, Sections 1, 3 and 5, T 1 N, R 6 E, and Sections 3, 5, 6, 7, 10, 14, 15, 16, 17, 19, 21, 22, 27, 28, 29, T 1 N, R 7 E, S. B. M.

Application No. 4851 (Placer County). Pacific Gas and Electric Co., 245 Market St., San Francisco, Calif., for 300 acre feet per annum from Six Mile Valley tributary to North Fork of North Fork of American River to be diverted in Section 25, T 17 N, R 12 E, M. D. M. for agricultural and domestic purposes to supply present demand for increase of sales to present irrigators along route of present Boardman Canal, domestic service for Colfax, Auburn and Newcastle. Estimated cost $1,500.

OREGON

The following applications for permit to appropriate water have been filed in the office of Rhea Luper, State Engineer of Oregon:

Dr. John B. Gregory of Wallowa, covering the appropriation of water from Bear Creek for irrigation of 18 acres in Wallowa County.

W. W. and C. F. Garrett of Grants Pass, covering the appropriation of water from Louse Creek for irrigation of 33 acres in Josephine County, at a cost of $500.

Ralph W. Allen of Adams, covering the appropriation of water from Wildhorse Creek for irrigation purposes in Umatilla County.

J. H. Paterson of Willamina, covering the appropriation of water from Carter Creek and La Follette Creek for irrigation of 12 acres in Polk County.

Thomas J. Tyrrell of Unity, covering the appropriation of water stored in Tyrrell Reservoir for irrigation of 70 acres in Baker County, at a cost of $1,800.

George B. Inks of Kerby, covering the appropriation of water from Illinois River for irrigation of 30 acres in Josephine County, at a cost of $500.

Victor Nault of Baker, covering the construction of the Nault Reservoir for storage of 49 acre feet of the waters of West Fork of Sutton Creek for irrigation of 20 acres in Baker County, at a cost of $5,100.

S. H. Edwards of Mayville, covering the construction of the Alderdale Irrigation Project Reservoir for storage of 16 acre feet of water from Thirty Mile Creek for irrigation of 100 acres in Wheeler County, at a cost of $1,000.

Pacific Live Stock Company of Burns, covering the appropriation of water from Big Springs for irrigation of 47.1 acres in Harney County, at a cost of $200.

R. J. Allen of Cove, covering the appropriation of water from Mill Creek for irrigation of 160 acres in Union County, at a cost of $1,000.

May and Anne H. Shogren of Portland, covering the appropriation of water from Mosier Creek for irrigation of 40 acres in Wasco County.

Jerry Fiala of Oregon City, covering the appropriation of water from Tualatin River for irrigation of 20 acres in Clackamas County, at a cost of $500.

Alex and Edna Ison MacDougall and Virgil S. Ison of Baker, covering the appropriation of underground percolation in the Pine Creek District for irrigation of 40 acres in Baker County.

J. B. Pilkington of Portland, covering the appropriation of Fanno Creek for irrigation of 40 acres in Washington County.

Roy F. Pugsley of Diamond, covering the appropriation of water from Keiger and McCoy Creeks for irrigation of 40 acres in Harney County.

Fred W. Falconer of Pendleton, covering the appropriation of water from Pumpkin Creek for irrigation of 40 acres in Wallowa County.

T. A. Sammis, Jr., of The Dalles, covering the construction of Mt. Hood Flat Reservoir for storage of 1600 acre feet of water from Dog River, Mill Creek and Three Mile Creek, and the construction of Five Mile Reservoir for storage of 15,500 acre feet from Dog River, Eight Mile Creek, Five Mile Creek and Three Mile Creek, and the appropriation of the stored water for irrigation and domestic purposes in Wasco County, at a cost of over $450,000. These filings are made for the benefit of a proposed irrigation district and will be turned over to the district if found feasible.

Thomas C. Fargher of Dufur, covering the appropriation of water from Denny Creek for irrigation of 22 acres, and from Mays Creek for irrigation of 6 acres, in Wasco County.

Con Fitzgerald of Plush, covering the construction of the Colvin Lake Reservoir for storage of 63.5 acre feet of melting snow for irrigation purposes in Lake County.

La Mesa Awards Contract

The bid of H.H. Peterson to install the new water distributing system for the Mt. Nebo residence section of La Mesa, California, was accepted, and contract awarded in connection therewith. The bid was in the amount of $20,913.13. The job includes the installation of cast iron water pipes throughout the entire section, the installation of a pressure pump, construction of a new concrete storage tank, and the installation of fire hydrants.

California Division of Water Rights Submits Annual Report for 1925

STIMULATED public interest in irrigation is traced to the long unbroken cycle of dry years through which California has been passing, by Edward Hyatt, Jr., Chief of the Division of Water Rights, in his annual report submitted during January.

The following are quotations from the report, summarizing some aspects of its activities during the year:

"The cycle of dry years through which the State of California has been passing remains unbroken which fact is stimulating public interest in all lines of effort which engage the attention of the Division. Out of a total of twelve typical California rainfall stations of the United States Weather Bureau which have reported to date only two, San Diego and Bakersfield, have had more than a normal precipitation and of the remaining ten stations Sacramento reports the lowest percentage of normal rainfall (37½ per cent) and Fresno reports the highest percentage of normal (97 per cent). These conditions have created an increasing demand for an accurate determination of the water rights on various streams and distribution of water by state agency to the several claimants in accordance with their adjudicated rights.

"While it is too early to venture a prediction as to the 1926 season, it is worthy of note that particularly in northern California the outlook is very unfavorable. At Sacramento and Red Bluff the seasonal precipitation on January 1st was almost identical with that at the same time in 1924 which was the driest year on record, and there was only two inches of snow at the Summit as against 32 inches on January 1, 1924. Southern California has been somewhat more favored than in 1924 in the matter of rainfall but the situation is hardly more encouraging in view of the fact that in many sections where wells are depended upon the ground water is at the lowest known level. . . .

"It is gratifying to be able to report a reduction in the number of applications awaiting action from 890 pending cases to 746, which is the lowest number awaiting action since 1920. This means that plans for development may be expedited. During the past year 465 applications to appropriate were received, 411 were approved, and 198 were cancelled. Since the office was first established in 1915 4857 applications have been received of which 2339 have been approved, 1772 have been cancelled and as noted above 746 are awaiting action.

"Fifteen suits have been instituted in the courts to secure reversal of action taken by the Division upon the 4109 applications approved or rejected and as yet none of these suits have been successful.

"The work of the Sacramento San Joaquin Water Supervisor which was undertaken in 1924 with funds provided by public subscription has been continued during the past season with funds provided by the last legislature. This work is costing approximately $20,000 per year and it is expected will be continued again throughout the coming year. This work is intended to provide an accurate record of diversions from Sacramento River and the lower San Joaquin River and Delta Channels, and also information as to water duty and available supply which will be invaluable in forestalling the threatened litigation between upper and lower water users on these two streams. . . .

"More than 600,000 acres of land in Fresno and Kings Counties are irrigated from the Kings River, by means of about 30 diversion canals. For 50 years there had been dissension and litigation between the various ditches when the subject was referred to the Division in 1922 for the preparation and operation of a schedule of diversions. Such a schedule was prepared and C. L. Kaupke appointed watermaster and since then the water available has been distributed by Mr. Kaupke in accordance with the schedule. Litigation has ceased and each ditch has actually received its agreed upon share of the water. In 1925 a difference of opinion arose among the Kings County canals but after a thorough investigation into its causes and a hearing at Hanford December 1st, the points of conflict were adjusted and the operation of the schedule for 1926 assured.

"Although the water of the San Gabriel River in Los Angeles County is small compared to other streams in California, it is one of the most important rivers and presents at the present time the most baffling technical and legal problems before the Division.

"A searching hydraulic investigation of the whole San Gabriel drainage area was started by the Division in 1923 and has progressed two years but due to the excessive dryness of these two years it has not yet been possible to secure needed data as to flow, absorption into the groundwater, etc., and the study must therefore be continued. The cost of the work has been advanced by local interests, the County of Los Angeles being the main contributor."

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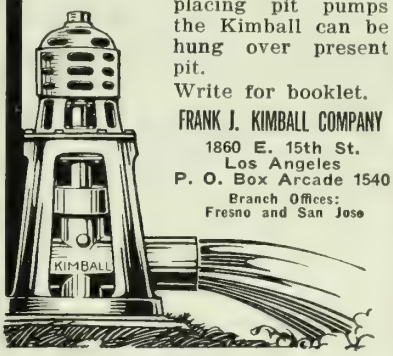

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AMONG OUR CONTRIBUTORS

Editorial Jottings About Current and Forthcoming Feature Articles, Dealing With Practical Problems of Hydraulics, and the Men Who Have Written Them

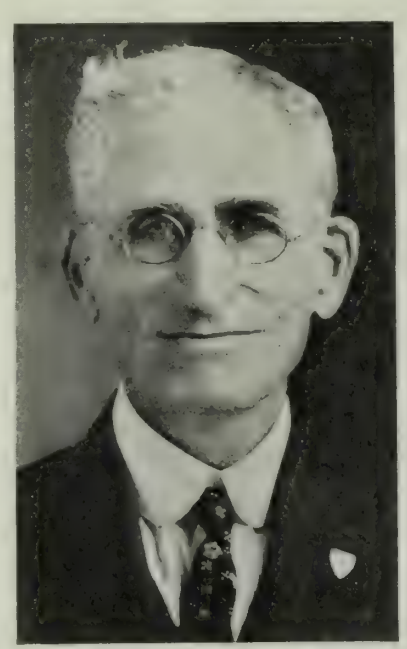
PROFESSOR FRANK ADAMS' varied career in the field of water development has already been sketched in this issue, in the article dealing with the group of the Board of Advisors of which he is a valued member. His article on "Conserving and Controlling Western Waters" is a part of a paper which he recently delivered before the western division of the Chamber of Commerce of the United States, meeting at Seattle, Washington. The second part of this paper, dealing with the close relationship which exists between conservation on the one hand and reclamation on the other, will appear in a later issue of the magazine.

ARTHUR P. DAVIS is also a member of the Board of Advisors of MODERN IRRIGATION, and his professional career has been sketched in our columns in preceding issues. He is, in very fact, the type of man of whom it may well be said that he needs no introduction, especially to an audience composed of representatives of the hydraulic industry. His engineering work has been of world-wide scope, including surveys for the United States government, from 1897 to 1901, of the proposed isthmian canals in Panama and Nicauragua, service as a member of the consulting board for the Panama Canal, consulting work for important hydraulic structures in Porto Rico, investigations for the government of Russia in Turkestan, studies of flood conditions in China, and service in various other capacities in China, Mexico, Alaska and many parts of continental United States. For more than twenty years he was identified with the Reclamation Service, and for almost ten years was its Director. He is now chief engineer and general manager of the East Bay Municipal Utility District, whose great water development project he describes in this issue.

WILLIAM L. ROCKWELL, who writes on the reconstruction plan of an important water improvement district of Texas, in the lower Rio Grande Valley, is another well-known engineer. His experience has included work in practically every part of the west. He was assistant city engineer of Spokane, Washington, 1888-1890; assistant engineer Yakima and Columbia Canal Company, 1891; 1892-1895, chief engineer Prosser Falls and Priest Rapids Irrigation Company, Washington; 1895-1898, chief engineer Stanislaus and San Joaquin Land & Water Company, a project covering 200,000 acres along the Stanislaus River in California; 1898-1908, hydraulic engineer employed jointly by the Kern County Land Company and Miller & Lux, large California water development concerns.

Since 1908 he has been actively connected with water developments in Texas, first in the service of the irrigation division of the United States Department of Agriculture, and successively in private practice and as consulting and supervising engineer for Hidalgo County Water Improvement District No. 4. In 1919, however, at the request of the Haitian government, he was sent by the Department of Agriculture to Haiti to investigate and report upon a proposed 90,000-acre irrigation project, the Cul de Sac, near Port au Prince. After submitting his report he resigned from the service of the Department and returned to Haiti and spent two years in planning the development of a large cotton and sugar-cane plantation.

Since his connection with the Hidalgo County developments he has, in addition to his work for the district, reported on irrigation features of eight different Texas projects varying in area from 30,000 to 150,000 acres. He is the author of numerous technical publications dealing with irrigation problems in Texas and elsewhere.



W. L. ROCKWELL

JOURNALS of the type of MODERN IRRIGATION seldom have the opportunity of welcoming contributors of the fairer and more poetic sex to their columns, but in this issue MISS CRISTEL HASTINGS has written an interesting sketch which combines in a most attractive way the practical and the romantic aspects of irrigation development. Miss Hastings in herself is a rather unique complex of interests, for in addition to being assistant secretary of the Pacific Coast Electrical Association, she is a writer and poet of more than local repute. Three magazines published in San Francisco are carrying stories written by Miss Hastings in their current issues, and she has just issued a new volume of verse, "Alta California," which is occasioning a good deal of interest among those who are not dry-as-dust technologists like the readers of this magazine. We feel, however, that all of us like some sweetness to lighten a more substantial diet, and Miss Hastings' story on the Morris Dam is welcome not only for the valuable information which it contains, but also for the romance which she has infused into a subject which the engineer envisions in terms of stresses, cubic-yards of concrete, and acre-feet of water.

The second installment of B. J. Seger's informing article on irrigation credit appears on Page 18. Mr. Seger is by this time no stranger to readers of MODERN IRRIGATION, having been introduced in these columns on the occasion of previous contributions.

CONTRIBUTORS to departments in this issue are men ably qualified to discuss the respective questions with which they deal. George M. Neel is state engineer of New Mexico. He tells of the major irrigation needs of that state. Hardy W. Campbell has spent almost a life time in reclamation and land settlement work for various railways, his present position being that of farm advisor for the Southern Pacific Company. Major O. V. P. Stout is identified with the Division of Agricultural Engineering, Bureau of Public Roads, of the U. S. Department of Agriculture, at Berkeley, California. He is chairman of the reclamation division of the American Society of Agricultural Engineers. Rhea Luper is state engineer of Oregon, and is intensely interested in and well informed upon both the financial and technical phases of irrigation developments of that state. M. R. MacKall is hydraulic engineer for the Railroad Commission of the state of California. His contribution in this issue is a continuation of his article in the December number, in which he dealt with the principles of public utility rate fixing.

SOME practical considerations of forest protection are now attracting considerable attention in the west on account of the legislation before Congress that would provide increased federal appropriations for this purpose. In the February issue, E. N. Munns, Chief of the Office of Forest Experiment Stations at Washington, D. C., will contribute a valuable article on the subject of "Fire and Water," in which the relationship between those two servants of mankind is forcefully brought out. Another interesting feature in the February issue will be a discussion of the experimental dam that is being constructed on Stevenson Creek, a tributary of the San Joaquin River, and will be tested to destruction by the Engineering Foundation of New York. The experiment will be one of the most interesting ever conceived by the engineering profession, for the dam to be destroyed and studied will be a full size arch dam, comparable in size to a large number of existing structures of the kind in actual service.

THE BUYERS' GUIDE TO LEADING SUPPLY SOURCES

Listing Practically All Standard Equipment Used in the Irrigation Country

THE IRRIGATION and hydraulic industry has, in the past, been greatly handicapped for the lack of some centralized Bureau of Information. Many jobbers, dealers and manufacturers representatives throughout the irrigation country have considered representation for commercial products of different types but did not know where to locate the names and addresses of the manufacturers of such appliances. The men who do ordering and specifying have not, in many cases, been able to consult an authentic directory of reliable equipment when writing for catalogs or quotations, compiling cost estimates or making out purchase orders. IN SHORT, THERE HAS BEEN NO STANDARD BUYERS GUIDE FOR THE INDUSTRY. It is in order that this need may be met, as adequately as possible, that MODERN IRRIGATION presents this current "Buyer's Guide to Leading Supply Sources," *corrected monthly.* It will, of course, become more complete as the publication grows in size. But since the present advertisers manufacture—or act as selling agents—for virtually all standard types of hydraulic equipment, this department should, at the outset, perform an invaluable service to buyers and sellers alike. The importance to the individual manufacturer of keeping his listings accurate and up-to-the-minute cannot be over-emphasized. Changes and corrections should be forwarded immediately. If any errors or omissions are noted in this month's listings, make sure that such incorrect listing will not appear again by sending your correction or revision by the next return mail. The listings "Main Branches or Agencies" are for branch offices or distributors in the irrigation country only and do not imply, necessarily, that the advertiser does not have branches elsewhere which are not included here.

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Montague Pipe & Steel Co.	Hobart Building, San Francisco, Cal.	44
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Northwest Engineering Co.	1727 Steger Bldg., Chicago, Ill.	39
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Pacific Pump Works Phone DE 6645—DE 6685	350 Bickett St., Huntington Park, Los Angeles, Cal.	27
Peerless Pump Co.	1916 E. 67th St., Los Angeles, Cal.	37
Pomona Mfg. Company	Pomona, Cal.	6
Price, G. W. Pump & Engine Company	1350 Folsom St., San Francisco, Cal.	49
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Sterling Pump Works

AIR LIFTS
Coast Machinery Corp. (See Climax Eng. Co.)
Kimball, Frank J. Co.

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Western Pipe & Steel Co.

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Commercial Iron Works

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American Steel Pipe & Tank Co.
Los Angeles Manufacturing Co.
Montague Pipe & Steel Co.
Western Pipe & Steel Co.

CHECK VALVES
Byron Jackson Pump Mfg. Co.
Commercial Iron Works
Vans Manufacturing Co.

CONCRETE MIXERS
Concrete Machinery & Supply Co.
Martin Iron Works

CONCRETE PIPE
Bent Concrete Pipe Co.

CONCRETE PIPE MACHINES
Concrete Machinery & Supply Co.
Martin Iron Works

CONCRETE PIPE MOULDS
Concrete Machinery & Supply Co.
Martin Iron Works

CONTRACTORS, WELL
Roscoe Moss Company

COUPLINGS, FLEXIBLE
Byron Jackson Pump Mfg. Co.
De Laval Steam Turbine Company

CRANES
Bay City Dredge Works

CULVERT, CORRUGATED
American Steel Pipe Tank Co.
California Corrugated Culvert Co.
Western Pipe & Steel Co.

DITCHERS
Bay City Dredge Works
Ruth Dredger Sales Co.
Northwest Engineering Co.
Owensboro Ditcher & Grader Co.

DRAGLINES
Bay City Dredge Works
Northwest Engineering Co.

DREDGING MACHINES
Bay City Dredge Works
Ruth Dredger Sales Corp.
Northwest Engineering Co.

DRILLING RIGS
Commercial Iron Works

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Westinghouse Electric Mfg. Co.

ELECTRIC MOTORS
Fairbanks, Morse & Co.
Westinghouse Electric & Mfg. Co.

ENGINE—DIESEL TYPE
Fairbanks, Morse & Co.

ENGINE—GAS, OIL, GASOLINE, DISTILLATE
Climax Engineering Co.
Charter Gas Engine Co.
Coast Machinery Corp. (See Climax Eng. Co.)
Commercial Iron Works
Fairbanks, Morse & Co.

FITTINGS, PIPE
American Steel Pipe & Tank Co.
Commercial Iron Works
Los Angeles Manufacturing Co.
Montague Pipe & Steel Co.
Western Pipe & Steel Co.
Woolwine Metal Products Co.

FLAP VALVES
Byron Jackson Pump Mfg. Co.
Commercial Iron Works
Martin Iron Works

FLOW METERS, ELECTRIC ORIFICE
Republic Flow Meters Company

FLOW METERS—STEAM, GAS & AIR
Republic Flow Meters Co.

FLOW METERS—WATER
Republic Flow Meters Company

FLUME, METAL
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Western Pipe & Steel Co.

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Martin Iron Works

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Concrete Machinery & Supply Co.
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Pomona Manufacturing Co.
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PIPE, CORRUGATED
American Steel Pipe & Tank Co.
California Corrugated Culvert Co.
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PIPE, GENERAL IRRIGATION
American Steel Pipe & Tank Co.
Lacy Manufacturing Co.
Los Angeles Manufacturing Co.
Montague Pipe & Steel Co.
Pacific Pipe Co.
Western Pipe & Steel Co.
Woolwine Metal Products Co.

PIPE, RIVETED STEEL
American Steel Tank & Pipe Co.
Lacy Manufacturing Co.
Los Angeles Manufacturing Co.
Montague Pipe & Steel Co.
Western Pipe & Steel Co.

PIPE, SURFACE IRRIGATION
American Steel Pipe & Tank Co.
Western Pipe & Steel Co.
Woolwine Metal Products Co.

PLASTER MIXERS
Martin Iron Works

POWER SHOVELS
Bay City Dredge Works

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Byron Jackson Pump Mfg. Co.
Fairbanks, Morse & Co.
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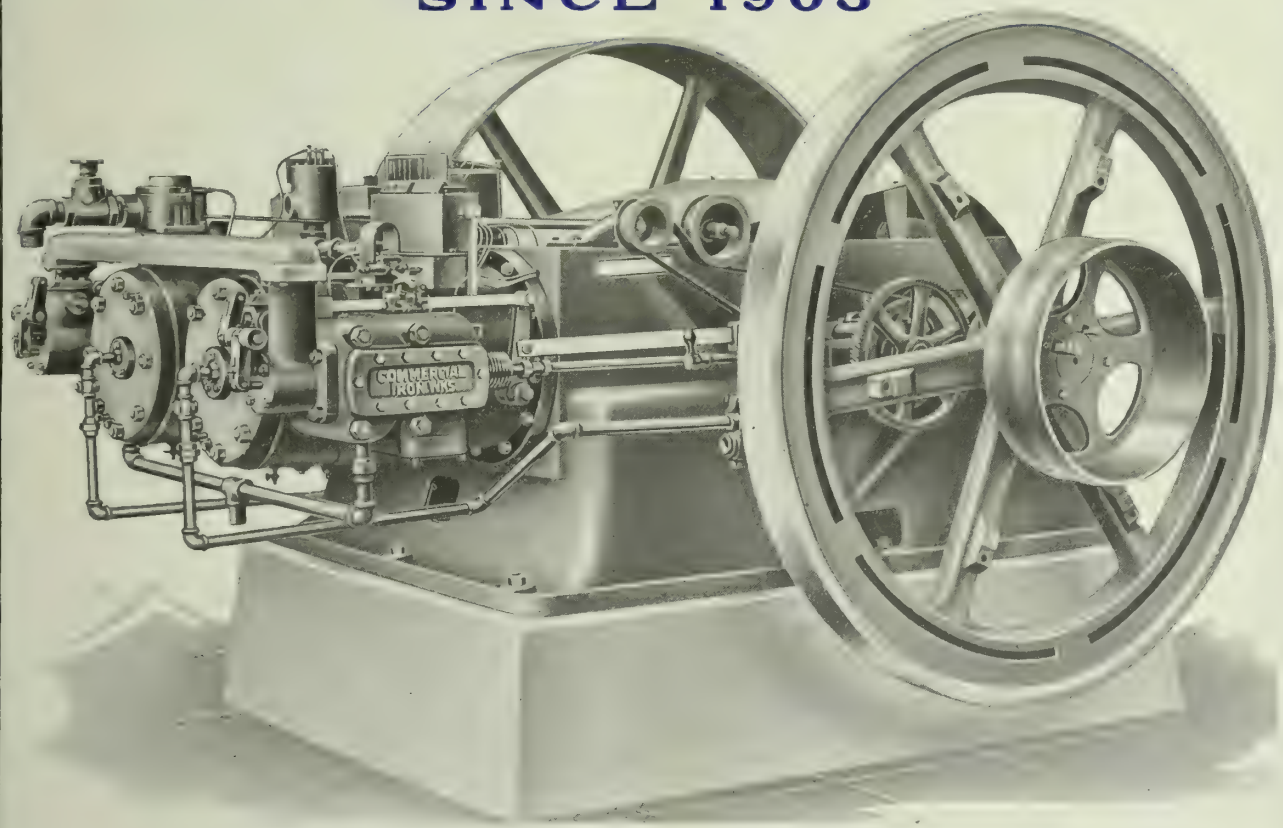

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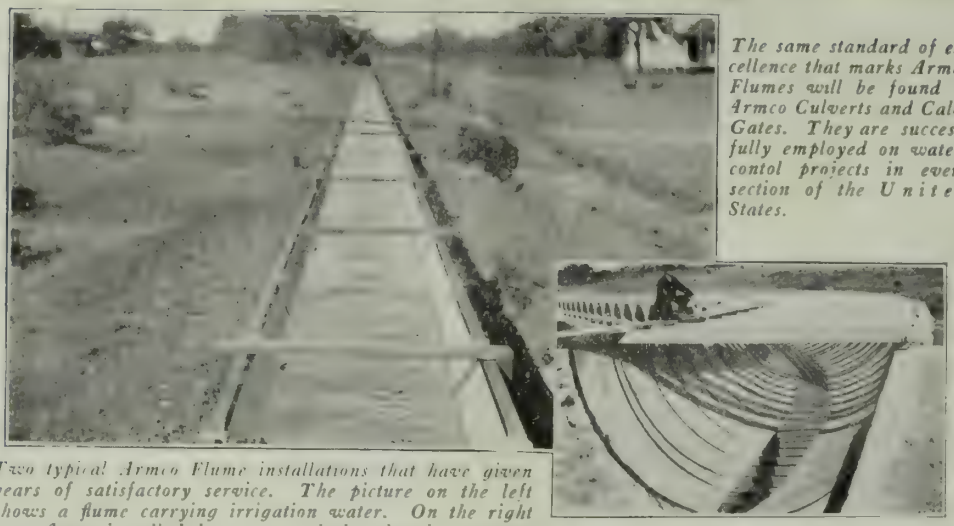

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For 12 Months: $2.00; Single Copies: 20 cents.

OWEN BROWN, President. W. C. MONROE, Vice-Pres. and Gen. Mgr. MINOR MOORE, Sec'y and Counsel

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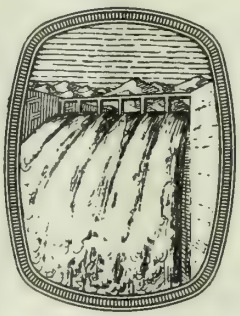
ARTHUR S. BENT

President of Bent Brothers, Los Angeles contracting firm whose activities touch hydraulic construction in many parts of the west. Mr. Bent, a former president of the Associated General Contractors of America, in January was chosen as president of the Los Angeles Chamber of Commerce, thus adding to an imposing record of service to his profession and his community the distinction of directing the largest commercial civic organization in the world.

MODERN Irrigation

The Magazine of Applied Hydraulics



Volume II FEBRUARY, 1926 Number 2

The Progress *of* Irrigation

JANUARY, as it took its departure, brought to the farmers of California and the Pacific Coast a copious and welcome rainstorm, which will mean much to western agriculture. In Los Angeles a total of more than three inches was recorded in slightly over 24 hours. The same storm brought to Sacramento a precipitation of 2.82 inches; to San Jose 1.50 inches; to San Francisco 1.86 inches; and greater or lesser amounts fell over the entire area of the state.

It is difficult, perhaps, for one not familiar with the present rainfall situation and the climatological character of California to appreciate what this one storm may mean to the state. It must be remembered that California has suffered through three very dry years, and has looked to the present "wet season" for relief—relief which seemed, until January's timely storms, to be fatally delayed.

At the beginning of the year Edward Hyatt, Jr., Chief of the Division of Water Rights, remarked the critical nature of the rainfall situation in the state in these words:

"The cycle of dry years through which the State of California has been passing remains unbroken. . . . Out of a total of twelve typical California rainfall stations only two, San Diego and Bakersfield, have had more than a normal precipitation. . . . While it is too early to venture a prediction as to the 1926 season, it is worthy of note that particularly in northern California the outlook is very unfavorable. Southern California has been somewhat more favored than in 1924 in the matter of rainfall, but the situation is hardly more encouraging in view of the fact that in many sections, where wells are depended upon, the ground water is at the lowest known level."

A single storm, no matter how generous, can not restore the balance after a long dry cycle, but the January showers and the rains which have followed, early in February, have brought measureless values to the farmers of the state in the intrinsic values of the water, the vital storage provided by the attendant snows in the mountains, and the encouragement which they bring as harbingers of more rains to come during the next two months, during which a fair proportion of the seasonal fall may be expected. The situation is still serious, of course, in spite of these encouraging signs.

Probably just as important as the rainfall was the much-needed snowfall in the mountains which attended it. The western farmer has long since learned that an unusually deficient rainfall may be eked out, upon occasion, by extra irrigation, but lack of the resource from which that irrigation comes can not be humanly supplied. The snowfall in the mountains of California was in even worse case than the rainfall at the beginning of the year. An official Weather Bureau report in January declared:

"Snowfall in the mountains during December, as in the preceding month, was markedly deficient and the accumulated depths remaining on the ground at the close of the month were unimportant. A few stations reported depths on the ground ranging from eight inches to 'patches' but an overwhelming majority reported the ground as bare. As California is dependent for its summer water supply for irrigating and for hydro-electric power upon a generous supply of well-packed snow in the mountains, the outlook to date is not very bright."

In the storm at the end of January, the precipitation reported from various mountain points indicated that the seasonal snowfall has been brought to approximately ninety per cent of normal. Three to four feet of snow over the entire watershed of the San Joaquin River was reported by the Southern California Edison Company from observations taken at the top of Kaiser Mountain.

FEBRUARY first was a day of rejoicing in the Banta-Carbona Irrigation District, located on the west side of the great San Joaquin Valley in California. On that day the pumps were started by the district for actual irrigation operations. The Banta-Carbona district includes 15,000 acres of excellent land—not an enormous district, but certainly a considerable addition to California's irrigated area. Not long ago the landowners of this district decided they needed water; banded together under the state irrigation act, formed the district, issued $830,000 in bonds, which were promptly taken by investors and financial institutions of the state, and today they have an irrigation district, newly functioning, representative of a fine type of modern technical and financial planning and execution.

Irrigation is not dead. It makes its mistakes; but the continual growth of the healthy body is not materially hampered. Such indications as the completion of this irrigation system are encouraging signs.

A TABULATION of California hydro-electric power plants, released by the Federal Power Commission in January, and appearing elsewhere in this issue, is of much interest in what it shows of the increasing correlation of hydro-electric and irrigation developments in the state. These two phases of the appropriation of water resources are correlative and complementary, and in most cases, one of them is incomplete without the other; and this fact is being increasingly recognized.

The same report indicates that California continues to lead in hydro-electric developments as well as irrigation progress. Of all the applications for permits to appropriate water for power purposes filed with the Commission since its creation in 1920, a third have come from California; and almost half of the total capacity contemplated in the development projects authorized by the Commission has been included in these California permits involving the installation of more than 1,600,000 horse power.

During 1925 a gain of twenty per cent is shown in the horsepower capacity of hydro-electric installations in the state. The new energy made available in that year amounted to 326,000 horsepower. California is rapidly becoming an industrial state, and much of her agriculture, also, is becoming industrialized, with the result that there is a constantly growing demand for electric power, which will undoubtedly continue, for a long time to come, to accelerate the simultaneous development of additional water and water-power projects.

SERVICE is an over-worked word; but a real and tangible type of service is the keynote of a program adopted by the Western Irrigation Equipment Association at its January meeting, as outlined in an article in another part of this issue. Publicity to aid the irrigator and the irrigationist to solve most scientifically their irrigation pumping problems, to promote a knowledge of farm hydraulics in the schools, to extend to the farmer the valuable information which the association has compiled, and to make the public conscious of its dependence on irrigation as a fundamental resource, these are the objectives of the year's work which the association is taking up.

These are laudable purposes. In accomplishing them, or in accomplishing the first steps toward their realization, the W. I. E. A. will be performing a real service for its industry. Fortunately, the scope of the organization is such, and its relation to irrigation in California is of such a character, that in promoting these broad and general objectives, the association will be furthering its own interest—the sale of irrigation equipment. This, of course, is what it is intended to do, but its primary effect will be to benefit not only the association and its members, but the whole irrigation brotherhood, and the entire body of society which, without realizing it, has its foundation in the development and application of water.

LEFT (Above) — Fire-swept slopes are subject to severe erosion which makes it difficult to reclaim the land further. RIGHT (Above)—Erosion following fire is responsible for the removal of tons of material annually from the denuded slopes of southwestern hills.

LEFT (Below)—This photograph shows the catchment basin behind the San Dimas stream gauge where records of flood after fire were obtained. Note the silt beds just showing up as the water goes down, yet only a small part of this drainage area was burned off in the 1919 fire.

Fire and Water

A Story About Water Without a Dry Word in It; Concretely Tracing the Relation of These Two Enemies

By E. N. MUNNS

Chief, Office of Forest Experiment Stations, United States Forest Service

ACCIDENT and experience early taught man that fire and water were mutual enemies. Modern man, building upon this common knowledge, has developed his city fire suppression measures to such a point that he no longer analyzes the relationship between these two elements in nature.

There is, however, a further, less intimate relationship between fire and water. This relation is that existing between forest fires and irrigation water. Whereas water commonly extinguishes fire, it may be said that in this relationship the forest fire in a measure extinguishes water.

Probably in no section of the country is this relation between fire and water more clearly recognized than in Southern California, where the writer has conducted many investigations into the nature and extent of this connection. Indeed, those who are dependent upon the water from the San Bernardino and San Gabriel mountains, and those who have their property in the direct paths of the stream whose major drainage area lies in these mountain masses, recognize it most poignantly. With water and improved land increasing in value, they have seen these cultivated lands swept away as the result of forest fires and boulder-strewn gravel beds left in their wake; they have seen bridges, highways, and railroads destroyed and travel made well-nigh impossible; they have found a smaller summer runoff when water was most needed, and an ever-lowering water table in their wells.

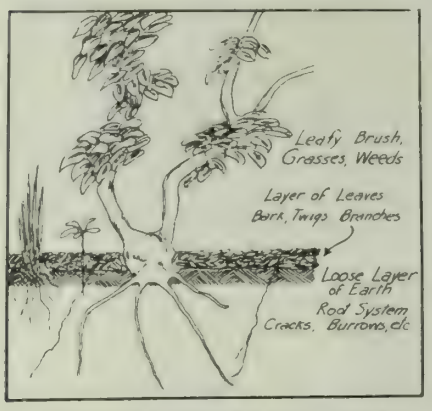
HOW THIS relationship works out is not always clearly understood, but investigations in the past ten years have disclosed many of the reasons. In the mountains of Southern California the principal soil cover is chaparral or brush rather than trees, a cover that is the result of the rather small annual rainfall, its limited distribution, and the long, warm, dry summer season.

The chaparral on typical slopes contains many thousand stems of many species, ranging in diameter from pencil size to four or five inches. The average of several small areas examined indicates that on some slopes as high as 32,000 stems are produced to the acre, or almost one to the square foot. Each stem of course produces leaves varying in quantity according to the species and the amount of light received, and each year a number of leaves about equal in number to the total number produced on the area fall to the ground, together with many small pieces of bark, twigs, and branches. Undisturbed, these accumulate and form a rough, more or less broken litter up to several inches thick. In the more open brush stands grow also numerous small weeds and grasses, which are usually inconspicuous except during the early spring, but which aid in forming the soil cover.

The combined effect of all the brush stems, the soil covering of leaves, twigs, and all plant growth, is to retard greatly the rapid movement of water down a mountain slope during a storm. This is accomplished in several ways. In the first place, a very high percentage of the precipitation runs down the stems directly into the ground and so tends to follow the roots into the soil. On the surface all rapid flow is reduced by the unevenness of the litter cover, while the cracks, crevices, and small plants permit the water to reach the soil without difficulty.

The retardation of surface flow is aided further by the absorption of water into the soil. Roots, both live and

decayed, assist in leading water into the deeper soil layers. The looseness of the top soil caused by frost and by the protection of the surface cover from sun, wind, and the heavy beating of rain, assists in water absorption and retention. Furthermore, with a good litter cover, insects of many kinds, worms, and even the larger ground dwellers, such as gophers and moles, dig and work the soil, aerate it, lighten it, and assist in



BEFORE THE FIRE HAS COME

mixing it to greater depths with the decaying litter, in such a way as to increase its water-holding capacity.

INVESTIGATIONS of the typical soil on a chaparral covered slope in the San Bernardino Mountains have indicated that the water-holding capacity of 100 pounds of soil was approximately 45 pounds or about 38 pounds of water per cubic foot of soil. Theoretically then, each square foot of soil is capable of holding the water obtained from a storm whose total precipitation is nine inches, without loss from runoff.*

But, let us consider the same area after it has been burned over. Very few brush stems will be left and these probably bare of leaves. All the litter will have been consumed and the soil surface exposed. The small plant life will be destroyed. There is now nothing to prevent the rapid runoff of the water, nothing to check its flow, nothing to assist the soil to absorb the water. There is little left but the bare soil with its light covering of ashes. At the time of the heavy rains the water sweeps down the slope unchecked. The ashes make a slime which seals the soil openings and greatly retards what little soil absorption is possible. The rain falling on the bare soil packs it harder and harder and tends to render it impervious.

*It should be remembered that the data given here are based upon a loamy clay soil derived from granite composition and supporting a mixed chaparral cover of oak, *Ceanothus*, manzanitas, etc. Other soils would undoubtedly not give the same results.

Did the fire hurt the soil? Did it reduce its water-holding capacity? The answer is that it did. The humus, which is more abundant in the surface layer of soil, and which assists greatly in increasing the water-holding capacity is largely burned out by the fire, while the top soil itself is baked by the heat and its physical composition changed for the worse.

UPON examination we find that the fire reduced the water-holding capacity of a cubic foot of soil from 45 per cent to 15 per cent, so that this cubic foot now holds but about 12 pounds of water. Translated into terms of rainfall, the soil could now hold theoretically but 3 inches of rain instead of 9 as before, leaving 6 inches to run off the area as flood water. Under actual conditions, of course, the amount of water absorbed by the soil at any one time depends in large measure upon the rate of rainfall.

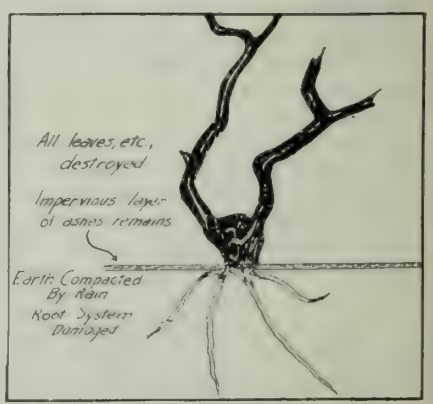
Much of this reduction in water-holding capacity may be ascribed directly to the fire by both consuming the material or by direct heat action converting the material into gases which were either consumed or passed off in the smoke. The action of fire was further supplemented by erosion. All of these factors work together. Studies indicate that the direct result of fire is to reduce the humus content from 16.48 per cent to 12.38 per cent, which in the 3 years following was further reduced to 6.42 per cent by erosion and the action of the sun.

The loss of two-thirds of the precipitation in the sudden run-off is a serious matter. In the first place, the floods occasioned by this heavy run-off are much heavier, longer, and more destructive than the floods from similar areas with uniform cover. The loss of this water also is responsible in part for the decrease in the level of the under-ground water, for the reservoir has no opportunity to replenish itself. Then too, the loss of this water means that there is less available on the area to support the vegetation which comes up after the burn or to appear in the later low-water flows.

There is a further loss, the loss of soil from the area. Under cover conditions, the water does not have the opportunity to collect in very large quantities or to flow in any large amount except in channels formed by repeated action. On the burned area, the water collects in every depression, gathers in every rill and run, and in a short time attains sufficient velocity to cut its own channel wherever it pleases. In these channels as it progresses down the slope the water increases in volume, and with increased volume attains a greater force. As is generally known, the carrying capacity of water increases rapidly with the increase in velocity, so that not only does each little run of water cut deeply into the soil, but it also carries off with it quantities of soil, to be deposited further down the slope.

IN THE first flow after the fire, the water carries off much of the ashes, and with this much of the valuable salts which are dissolved out of the ash. With these ashes the finer humus particles from the top soil, when not destroyed by fire, the charcoal and unburned material which would later break down and so add to the humus of the soil, are also washed away. At the same time are carried away the very fine soil particles, the colloids or silt material which are often the life of the soil. The water collected during these floods is heavy with silt. With all this material are smaller particles of soil and earth, to which are added, as the velocity of the water increases, sand, gravel, and small sized rocks.

How much material is brought down during a flood flow from a burned-over area is difficult to estimate because of the differences in topography, soil, and



AFTER THE FIRE HAS PASSED

precipitation conditions. From a burned area of 1.2 square miles in Haines Canyon, engineers estimate that 100,000 cubic yards were moved by the storms of the winter following the fire of 1914. Erosion from the burned areas in San Gabriel and Dalton Canyons in 1919, following the big fire of that year, was not as severe but probably equalled 75,000 cubic yards during the winter. Studies indicate that from 10 to 120 cubic yards of material per acre of burned area were moved. At various times it has been estimated that nearly 1,000,000 cubic yards have been removed from the denuded slopes of the Los Angeles and San Gabriel River drainages since the destructive fires of October, 1919,

(*Continued on Page 43*)

How Water is Controlled and Administered in a State That has Plenty of It

By R. K. TIFFANY*

State Supervisor of Hydraulics, State of Washington

Although Washington has bountiful water resources, thousands of acres of desert land are awaiting the development of these resources for their reclamation.

NATURE has been kind to the commonwealth of Washington in her bestowal of the resources essential to human health and happiness, and in nothing has she been more lavish than in the bountiful supply of water.

In thinking of its many uses our minds turn readily to the sparkling streams that furnish cities and towns with the pure water necessary for the many uses of home, civic and industrial life; to the magnificent harbors through which we receive products of every clime, and in turn reach with our products the markets of the world; to the falling streams which, through the magic of the engineer, furnish us with light and power to brighten our lives and lighten our burdens; to the artificial rivers that make the desert blossom as the rose; to the many beautiful lakes that afford us pleasure, recreation, yes, even inspiration in our leisure hours.

BUT, in the face of all these and many other important uses, it was not until 1917 that the people of Washington realized the necessity of orderly control and regulation of their water resources, and enacted what has since been known as the "Water Code" of the state.

The Water Code of Washington follows closely that of her sister state, Oregon, and the basic principles laid down many years ago by Dr. Mead in the water code of Wyoming, one of the first western states to substitute by statute the doctrine of appropriation for the old and generally accepted one of reparian rights.

It establishes police control by the State of all waters within the State and public ownership of all waters subject to rights existing at the time of its passage, and that any right to such waters or their use shall be acquired only by appropriation as by statute provided. While it specifically saves existing rights of riparian owners it provides that their amount and priority may be determined by proceedings under the statute, and owners and claimants of important riparian rights have found it desirable, in undertaking substantial development, to proceed under the plan of appropriation provided by the code rather than to rely upon intangible and uncertain rights which might accrue through riparian ownership.

The Code provided for administration through a State Hydraulics Engineer. This office was abolished by the Administrative Code of 1921, and its duties taken over by the State Supervisor of Hydraulics under the newly created Department of Conservation and Development.

The principal purposes of the Code are set out in the duties of the office as follows:

1.—To supervise public waters within the State, their appropriation, diversion and use.

2.—Insofar as may be necessary to assure safety to life or property, to inspect the construction of dams and other structures pertaining to the use of water.

3.—To regulate and control the diversion of water in accordance with established rights.

4.—To determine the discharge of streams, springs and other sources of water supply and the capacity of storage reservoirs.

5.—To keep proper records of water rights and issue certificates thereof.

6.—In conjunction with the courts to determine the relative rights and priorities of users of water.

New rights are acquired by procedure common to several western states, through filing of application with the State Supervisor of Hydraulics and publication of statutory notice. Examination is then made to determine whether there is public water available and whether the proposed use will impair existing rights or be detrimental to public welfare; and if satisfied on these points, permit is issued.

Where the proposed use conflicts with existing rights *or threatens to prove detrimental to public interest having due regard to the highest feasible use of the water belonging to the public,* it is the duty of the Supervisor of Hydraulics to reject the application.

PERMIT may issue for a lesser amount of water than that applied for if substantial reason therefor is found, but in no event shall permit issue for more.

In determining whether permit shall issue it is the duty of the Supervisor *to investigate all facts relevant and material to the application.* It would appear that taken with the repeated reference to public welfare and public interest, this provision should be construed to require investigation of such matters as the financial ability and experience of the applicant to carry out the proposed development. With increasing demand for economical power sites this phase of investigation assumes great importance. Irresponsible and incapable speculators should not be permitted to make filings that will prevent or delay real development.

Proceedings to determine existing rights may be initiated by petition of interested parties or by the Supervisor if, on investigation, he determines that the interest of the public will be served by the determination of water rights upon any stream or group of streams. Action is brought through the Superior Court, and all known claimants are made parties. Through the office of the Supervisor of Hydraulics, field examinations are made to determine the land irrigated and irrigable, canal capacities and locations, amount of stream flow, uses and rights for other purposes than irrigation and other facts, if any, bearing upon the case. A map and Statement of Facts are filed with the court, and all claimants are required to file statement of rights claimed by them, on forms furnished by the Supervisor.

*A paper delivered by the author at the third midyear meeting of the Western Division of the Chamber of Commerce of the United States, at Seattle, Washington.

The court then refers the proceedings to the Supervisor of Hydraulics to take testimony as referee. After all testimony is submitted it is carefully analyzed by the Supervisor and a report of his findings is made to the court, based upon testimony and the facts gathered through his office.

ALL PARTIES appearing before the referee are given an opportunity to examine his report and to file with the court exceptions thereto. Upon consideration of the report and of the exceptions, if any, the court finally issues a decree fixing the relative rights and priorities of all claimants, and water right certificates are issued by the Supervisor of Hydraulics in accordance with such decree.

The cost of all proceedings is assessed against the lands benefited, and payment of cost must be made before issuance of water right certificate.

The Supervisor of Hydraulics, acting through deputies, water masters and stream patrolmen, regulates diversions from streams in accordance with established rights. Salaries of the water masters are paid by the counties in which they are located. Stream patrolmen, operating under the direction of water masters, are paid for their services by the owners of lands directly benefited.

The builder of any proposed dam or controlling works for storage of more than ten acre-feet of water is required to submit to the Supervisor of Hydraulics plans and specifications for examination and approval as to its safety. With the organization of the Division of Water Resources limited as it is by available funds and so largely occupied by routine work in connection with the issuance of new and the determination of old water rights and stream regulations, this examination of plans is likely to be more or less perfunctory, particularly with reference to plans which are prepared by municipalities or large corporations having a capable engineering staff. Where the construction is in less experienced hands efforts are made to give all essential care both to the plans and specifications and to field inspection.

A nominal fee of $5.00 is required with all applications, this being called an "examination fee". It is insufficient to cover the actual cost of examinations, and a bill has been submitted to the legislature now in session, asking for a material increase in examination fees. It is hoped that this bill, if enacted into law, will have two desirable results; first, to increase the revenue of the office sufficiently to permit of adequate examination of all applications; second, to eliminate through a substantial charge, many filings made by irresponsible persons for purely speculative purposes.

Fees for filing of permits to appropriate water are:

For irrigation—10 cents per acre up to and including 100 acres; 5 cents per acre between 100 and 1000 acres; 2½ per acre for areas in excess of 1000 acres.

For power—10 cents for each theoretical hrosepower up to 100; 5 cents for each theoretical horsepower between 100 and 1000; and 1 cent for each theoretical horsepower in excess of 1000.

Washington has no annual license fee based upon the use of water, although some consideration has been given to the desirability of such a fee, sufficient only to cover the cost of operating the Division of Water Resources.

THE Code has been in effect since 1917, and in this period of eight years there have been filed 1550 applications for permits to appropriate waters; 594 permits have been issued; and 84 final Certificates of Water Right.

Under the provision for determination of old rights, 27 cases have been handled or are in process, covering 48 streams and involving 1705 water rights for the irrigation of 120,900 acres of land. Petitions are on file asking for determination of rights on 31 other streams. Certificates numbering 601 have been issued covering approximately 88,800 acres of land.

Under the provision for stream regulation, water masters in 11 counties have partly or wholly regulated diversion of water during the irrigation season from 63 streams.

The Division of Water Resources cooperates with the U. S. Geological Survey in stream gaging work on the major streams of the State. On the smaller streams miscellaneous measurements have been made, usually during the low water season, of some fifteen hundred only of the several thousand small streams within the State.

Washington has irrigation projects that have been investigated and found feasible for an aggregate area of 3,113,400 acres. More than half a million—575,400 acres—are now irrigated leaving approximately 2,538,000 acres for State development. The cost of these projects will be high, but with the high average returns established by existing projects, and with the rapid industrial and commercial development evidently in prospect for the entire Pacific Coast, it is believed that irrigation in Washington should and will proceed at a rate necessary to maintain a proper balance between agricultural production on one hand and commercial and industrial development on the other.

According to Dean Magnusson, Professor of Electrical Engineering at the University of Washington, we have within the State potential water power resources amounting to 8,647,000 horsepower, of which only 454,356 or 5.2 per cent has been developed. It is evident from these figures that the conservation and development of the water resources of Washington mean much to the State and nation, and that in the regulation and control of the waters of the State we have a public duty and a problem of present and ever-growing importance.

To Use San Marcos Creek

According to plans for a new irrigation district near San Diego, California, waters of the San Marcos Creek would be used to cultivate an area of 4000 acres. Application for permit to appropriate this water has been filed by R. E. Rule, engineer, of Coronado.

Albany Falls, on the Pend Oreille River, intake for the proposed Columbia River Basin project, (Washington).

Conserving and Controlling Western Waters

2-Land Settlement and Reclamation as Conservation Problems*

By FRANK ADAMS

Professor of Irrigation Investigations and Practice, College of Agriculture, University of California.

SINCE use is conceded to be the first step in the conservation and control of water, the construction of works of reclamation and the problems and policies connected with such construction likewise fall within the field.

The historical background of our present problems of western reclamation is well understood and need only be touched upon briefly. It is sufficient, probably, to say that we have learned how to do, and to do well, those things in reclamation that individuals and communities and even the Government can do singly, and henceforth must undertake our major reclamation in the West on the basis of wider relationships.

By this is meant that we must think in terms of the general situation in agriculture, including the markets for farm products, and the resultant effect of this general situation on the productive value of land; of the relation existing between arid land reclamation and reclamation of the unused lands of the northeast, the swamp lands of the south, the unused cut-over lands of the northcentral and northwestern states, and the productive but naturally wet lands scattered throughout the country that need drainage; of inter-state water compacts; of how we are to finance works of reclamation too costly to be wholly paid for out of the returns from agriculture, but which have their ample justification in the general benefits they will create; and of how the resources of the State and Federal governments, of local communities, of irrigation or drainage or reclamation districts, of interested landowners, of credit agencies, and of industrial and commercial bodies can collectively be employed to the end that our reclamation activities shall conform to the principles of conservation that we acknowledge to be basic.

Obviously, the details of all of these questions can not even be referred to, much less discussed, in this brief article. It is desired, however, to discuss briefly, as strictly water conservation problems, the questions of land settlement and of a larger measure of state and government aid in reclamation financing. The first of these is pre-eminently a question of the present, and until it is solved we shall make very little real reclamation progress; the second looms as the next major reclamation problem to face and work out.

THE BEGINNING step in connection with land settlement is to recognize it as a problem. When one considers the persistence and sometimes even the bitterness with which attempts to meet this problem have been opposed, one almost feels inclined to look upon the recognition of its existence as more difficult to bring about than its solution. However, we can not belittle the difficulties of the solution for we have not overcome them. We have not even begun to agree on a procedure for overcoming them. We should, however, be able to reach a common understanding on some of the underlying principles of the question, and with this in view the following are suggested:

(a) That the old idea that at least three settlers should fail before one can be expected to succeed is untenable from the standpoint of true conservation. It is not only a brutal conception, reeking with social injustice, but it is grossly uneconomic in its misapplication of effort and its dissipation of working capital.

(b) That the problems of settlement are more than the mere sale of land through the usual channels of real estate agencies, but, on the contrary, require and demand organization and planning before the works of a project are constructed.

The first responsibility in this organizing and planning is with the agency proposing a project; the second is with the community of which the project, when developed, is to become a part; the third, in the case of irrigation or reclamation districts, is with the State agency that approves or purchases the construction bonds.

There is little doubt that the above is fully recognized by the three states that have been extending direct financial aid to irrigation, reclamation, or drainage districts. It is not so clear that all of the other states yet recognize it. It is very certain that few who are proposing new projects have done so.

(c) That the number of prospective settlers who have sufficient working capital to establish a typical family farm and bring it to production without larger credit than is usually now available is too small to warrant reclamation construction at the rate prevalent during the past decade.

(d) That if the present or a more rapid rate of reclamation development is desired some agency—government, state, community, or individual—must supplement the inadequate capital of the usual settler.

The only plan for doing this thus far worked out is that of assisted settlement successfully in effect in some other countries, and under consideration for adoption by the State and Federal Governments in connection with development under the Reclamation Act.

(e) Finally, that the speculative differential between the value of land prior to the construction of irrigation works and the sale price to the farmer who is to complete the work of reclamation is the basic evil of all in Western conservation development.

DURING the past few years a feeling has been growing in the West that in some way the public must in the future bear a larger part of the cost of reclamation than heretofore. This is because the capital costs to farmers on irrigated land are increasing to the point of jeopardizing their success. The contribution from the Federal treasury has been considerable on the Government projects because no interest has been charged on deferred payments. This Contribution will be even greater under the revised plan of limiting required annual payments on construction to five per cent of the gross annual return to the settlers on the projects. There has been no contribution on district or private projects to balance this except as Oregon, Washington, and Wyoming have given temporary aid by the purchase of interest or principal of irrigation or drainage districts bonds, these advances to be later repaid to the States.

So long as reclamation costs are kept down to the amounts the returns from agriculture in the long run will justify, the question of introducing a form of public aid under which part of the capital cost would be contributed by the public is not likely to gain headway. Some even feel very strongly that the present Federal contribution, through not charging interest, should be eliminated, yet to change such a policy as this is not an easy matter in the face of certain strong western opposition. Now that the

(*Continued on Page 24*)

*This article is the second and concluding instalment presented by MODERN IRRIGATION from Professor Adams' paper on "Conservation and Control of Western Waters" presented to the recent meeting of the Western Division of the Chamber of Commerce of the United States.

Building a *Dam* Marked for *Destruction*

Engineering Foundation Sponsors Experiment to Test Current Theories of Dam Construction

By FRED A. NOETZLI

ONE of the most interesting scientific tests ever conceived soon will be made not far from Fresno, California, when a full size test arch dam will be built for experimental purposes.

The object of the tests is to determine the distribution of the stresses in an arch dam under field conditions. It is believed that the experiments on the Test Dam will either confirm the correctness of one of the existing arch dam theories (cylinder or elastic arch theory) or lead to the development of a new theory upon which the design of future arch dams can safely be based.

There has been a demand for lower cost of dams while conserving safety and permanency, for power development, water supply, irrigation and flood control. Engineers have therefore tried to design and build dams of arch and multiple arch type, using less material than the old type of gravity dam. Some of the arch dams built are very thick, others very thin. Either there has been a waste of material in the thick dams or the limit of safety has been closely approached in the thinnest.

In an endeavor to get more knowledge on this subject The Engineering Foundation of New York in 1922 named a committee of engineers to undertake a study of arch and multiple arch dams. During the past three years a number of service dams have been equipped with suitable instruments for measuring deflections, stresses, temperature changes, etc., and observations are being made periodically on these dams.

Furthermore, a fund has been collected for building an experimental arch dam comparable in size to a number of existing dams. The Southern California Edison Company offered a large contribution and the use of remarkably suitable facilities at a site on Stevenson Creek, about sixty miles east of Fresno, California. At this site the dam is now under construction and may be safely tested to destruction, if possible. The dam will first be built to a height of 60 feet and tested repeatedly under a variety of load and temperature conditions for about one year. In the event that the dam does not fail at the height of 60 feet, it may be raised in steps of 10 feet each to a height of about 100 feet, when the water pressure will probably be so large as to crush the dam. The proposed experiments will be made under field conditions. Deductions will be carefully drawn from the test data by the Committee in charge of investigation.

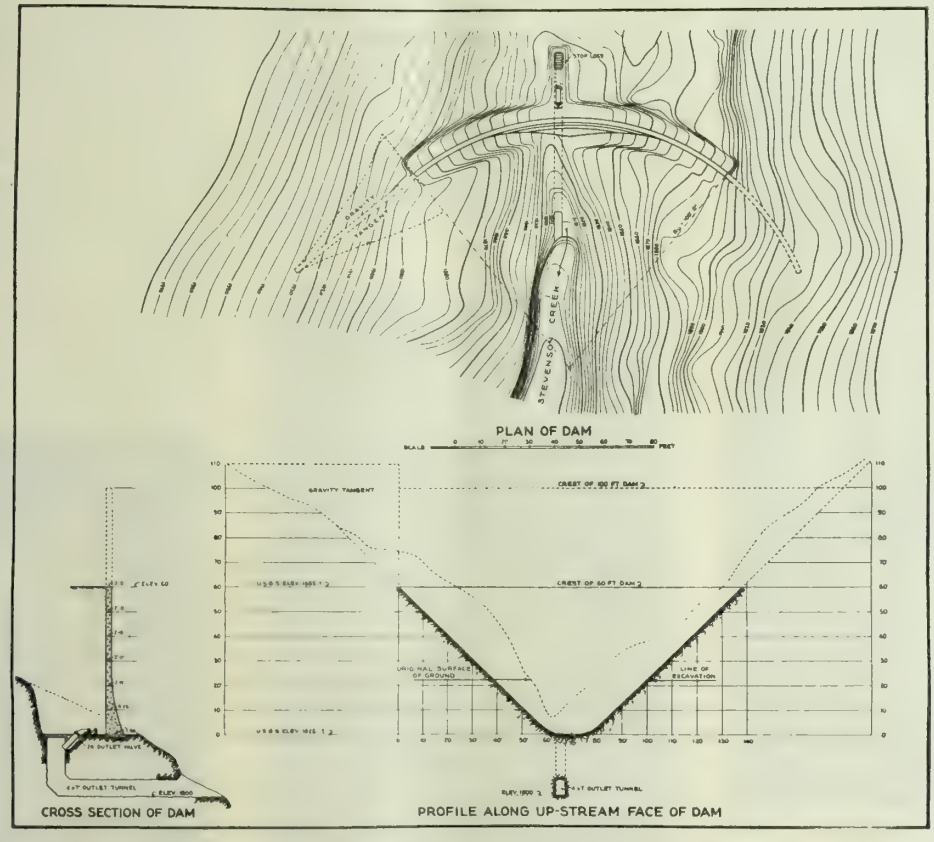
BUILT only to be destroyed—that is the fate of a dam to be built for experimental purposes on a site near Fresno, California, shown in the illustration above. Construction and hydraulic engineers expect that the tests to be made in this connection may reveal new and extremely valuable data touching existing theories of dam construction.

The test dam on Stevenson creek is an arch dam of the simplest type. The up-stream face is vertical, and the up-stream radius is 100 feet. The dam is 7.5 feet thick at base and 2 feet thick at Elevation 30 and above. The bedrock was excavated on both side abutments so as to provide a symmetrical profile. This arrangement will tend to avoid any complications that might arise from irregular profile, variable arch radius, etc.

The site on Stevenson Creek is remarkably favorable for the construction of the test dam. The foundation conditions are excellent, the bedrock being solid granite. The span of the dam is about 20 feet at the base and about 125 feet at a height of 60 feet above the foundation. The dam and reservoir are located entirely upon government land. The natural flow of Stevenson creek is diverted a few miles above the dam site. A power tunnel of the Southern California Edison Company passes just above the dam site and an adit to this tunnel equipped with a valve will permit of filling the reservoir in a very short time. The capacity of the reservoir behind a dam 60 feet high is less than 5 acre feet. These exceedingly favorable conditions will offer perfect control of the height of water in the reservoir without depending on or being influenced by the natural flow of the creek.

It is proposed to build the dam first to a height of 60 feet and test it repeatedly under various load and temperature conditions in the course of about one

year. During the construction of the dam a large number of instruments for measuring strains, temperature variations and deflections are being placed into the concrete and at a large number of points on the up-stream and down-stream side of the dam. The Bureau of Standards has developed a special instrument of the carbon resistor type which can be placed in the concrete or on the up-stream face of the dam below the water line, and which registers, by an electrical device, the strains which occur in the concrete under the loads imposed upon the dam. The strains will be measured at a large number of points in horizontal, vertical and inclined directions. The deflection of the arches at various elevations will be measured at the arch crowns and in several other vertical sections.


PLAN OF DAM
CREST OF 100 FT. DAM
CREST OF 60 FT. DAM
ORIGINAL SURFACE OF GROUND
LINE OF EXCAVATION
CROSS SECTION OF DAM
PROFILE ALONG UP-STREAM FACE OF DAM

Plan, Cross-section and Profile of Test Dam to be Tested to Destruction by Engineering Foundation's Committee on Arch-Dam Investigations.

WHILE the Test Dam is being built there will be cast a large number of specimens from the batches of concrete for the purpose of making laboratory tests. Some of these tests will be made in a room near the dam. For more refined tests specimens will be sent to the Engineering Laboratory of the University of California in Berkeley.

The Committee on Arch Dam Investigation, under whose direction and supervision these experiments will be conducted, consists of the following members:

Chas. D. Marx, Chairman, Professor Emeritus, Stanford University, California; Fred A. Noetzli, Secretary, Consulting Engineer, 928 Central Building, Los Angeles, California; Professor C. Derleth, Jr., University of California, Berkeley, California; (Alternate: Professor R. E. Davis, University of California, Berkeley); F. E. Weymouth, formerly Chief Engineer, U. S. Bureau of Reclamation, Denver, now President, Brock & Weymouth, Inc., Philadelphia; (Alternate: Julian Hinds, Research Engineer, U. S. Bureau of Reclamation, Denver); W. F. McClure, State Engineer of California, Sacramento; (Alternate: Paul Bailey, Deputy State Engineer, Sacramento); M. M. O'Shaughnessy, City Engineer, San Francisco; (Alternate: R. P. McIntosh, Designing Engineer, San Francisco); H. Hobart Porter, Sanderson & Porter, New York; (Alternate: Wynn Meredith, of Sanderson & Porter, San Francisco); Silas H. Woodward, Consulting Engineer, New York; H. Hawgood, Consulting Engineer, Los Angeles; D. C. Henny, Consulting Engineer, Portland, Oregon; H. W. Dennis, Construction Engineer, Southern California Edison Company, Los Angeles; Alfred D. Flinn, Director, Engineering Foundation, (formerly Deputy Chief Engineer, Catskill Aqueduct).

H. Hawgood is Chairman of the subcommittee of the Test Dam, and H. W. Dennis is in charge of the construction of the dam. W. A. Brackenridge, Senior vice-president Southern California Edison Company, Los Angeles, is trustee of the fund for the Test Dam.

RECOGNIZING that the direct and indirect results of this investigation will be of broad general value, Dr. George K. Burgess, Director of the Bureau of Standards, has assigned W. A. Slater, Engineer Physicist and well known experimenter in concrete, to have resident charge for the committee. The Bureau is also contributing the services of other members of its staff in its laboratory at Washington and in the field. Similarly, the Coast & Geodetic Survey is contributing the use of instruments and men. Funds, materials and services have been contributed by more than 40 power companies, construction firms, bankers, engineers, manufacturers and others. Contributions have ranged from $500 to $25,000. To date about $78,000 have been contributed to the Test Dam Fund.

The dam will probably be completed next March. Tests are being made during the entire construction period. The first experiments with the dam under pressure will be made as soon as the concrete has sufficiently hardened to carry the load imposed upon it by the water in the reservoir.

SNOW FALL HEAVY IN MOUNTAINS

Irrigationists in California who have been watching with deep concern the reports of snow falls in the high Sierras, were heartened by the welcome additions to snow accumulations recorded during February, beginning with the considerable storm early in the month.

On February 12, as this magazine went to press, current reports from the Southern California Edison Company's observers at Huntington Lake and other points in the Big Creek district indicated that practically normal snow conditions had been restored by the February storms in that section.

Sixty-eight inches of snow were reported on the level at Huntington Lake, which has an elevation of 7000 feet; and at the 5000 foot levels more than a foot of snow was on the ground.

According to officials of the Edison Company, the complexion of the outlook for snowfall has changed entirely within the month, practically normal conditions having been restored, and the outlook for the year being distinctly encouraging. Similar reports were received from various mountain points. There was three feet of snow at Big Bear.

New Members from Three States Accept Places on Magazine's Corps of Advisors

Arizona, Oregon and Idaho Represented by Three Authorities Newly Added to Editorial Board

PART of the plan upon which MODERN IRRIGATION was launched was the enlistment of a Board of Editorial Advisors, representing the leadership of various divisions of the hydraulic industry, whose interest in

W. G. SWENDSEN

the magazine would be at once an evidence of the solidity of the principles upon which it was established, and a guarantee of its direction in constructive and well considered channels.

The advisors who comprised the board in the beginning were, without exception, California men, although many of these hold places of national and international prominence in irrigation. There was a definite reason why only California men were selected for invitation. It was the purpose of the publishers to enlist, not only the names of the board members, but their actual, active interest and enthusiasm, based upon confidence in the need for the magazine and its capacity for meeting that need. For this reason, only those men who could be seen personally were invited to become members of the original board.

Now, however, commencing the second volume of the publication, MODERN IRRIGATION intends to extend the personnel of its Board of Advisors to an area coextensive with its avowed field of service—the entire western United States. Representatives of the irrigation industry's leadership in various sections of this territory are being invited to join the Board of Advisors. Their acceptance will be announced, and they will be presented, by word and picture, in future issues of the magazine.

In this issue, it is the publishers' privilege to introduce three well known irrigationists who have accepted membership

W. L. POWERS

on this Board: G. E. P. Smith, of Arizona; W. L. Powers, of Oregon, and W. G. Swendsen, of Idaho.

Warren G. Swendsen

The professional career of Warren G. Swendsen has brought him into intimate contact with hydraulic developments in many parts of the country, especially in the northwest, where he is now an acknowledged authority as State Engineer and Commissioner of Reclamation of the state of Idaho.

He was graduated from Utah Agricultural College in 1903 with the degree of Bachelor of Science in Civil Engineering. His early experience was gained with the Federal Reclamation Service in Utah and Idaho. From 1907 to 1910 he was in the employ of the Telluride Power Company as construction engineer, directing the design and construction of hydro-electric plants in Idaho, Utah and Colorado. For four years following he engaged in private practice with headquarters at Boise, Idaho.

The work in which he was engaged during this period included the planning and construction of irrigation projects, power plants and other hydraulic works in Idaho, Utah, Nevada, California and Oregon. In 1914 and 1915 he removed to the south, where he devoted himself to drainage work, with headquarters in New Orleans, but in the latter year he was recalled to the northwest to serve the joint Utilities Commissions of Idaho

G. E. P. SMITH

and Washington in expert appraisal work. In 1917 he again returned to private practice, doing general consulting work in irrigation and other hydraulic problems.

In 1919 he assumed the position which he now holds as State Engineer and Commissioner of Reclamation of Idaho. In this office he has statutory jurisdiction over all matters pertaining to the development and use of public water, dams, and construction of irrigation and power works. He was collaborating sanitary engineer for the U. S. Public

(Continued on Page 28)

What Irrigation Has Done For My State—*IDAHO*

By ADDISON T. SMITH

MR. SMITH is Congressman from Idaho, and chairman of the House Committee on Irrigation and Reclamation. His is the first of a series of articles to be presented in MODERN IRRIGATION, *in which eminent westerners will tell what irrigation has meant to their respective states.*

IRRIGATION has meant much to Idaho. In 1860 the irrigated area of the state comprised but 1931 acres with an aggregate value of about $50,000.

In 1920 there were 2,489,000 acres, comprising more than 25,000 individual farm units under irrigation, with a value of farm lands alone of $360,000,000. During this period Idaho's population increased from 15,000 to 432,000.

The cost of constructing the irrigation works to cover the area under irrigation in 1920 was approximately $9,500,000. When it is remembered that the $360,000,000 valuation does not include the value of city, town, village, municipal and other property values, to say nothing of the homes which have brought contentment and happiness to thousands of people, this investment in irrigation, from a purely commercial standpoint, demonstrates an abiding faith in Idaho's destiny.

The revenue from this irrigated area is reflected in the 1922 census records, which show a crop value from these lands of more than seventy millions of dollars. Over 200,000 people are provided with employment in the various activities incident to the use and cultivation of this area.

JUST as the building of the first irrigation works, and the first use of water on Idaho soil in 1860, marked an epoch in the history of the development of the territory, the building of the American Falls reservoir, now under construction in southern Idaho, marks an epoch in the state's history.

When completed, about two years hence, this project will impound approximately 1,700,000 acre-feet of the flow of the Snake River, capable of affording a supplemental supply of water to enable the settlers already on the land to irrigate about 1,500,000 acres of the richest and most productive soil in the world.

Confronted with a cost of about $7,000,000 the farmers of this section, by an overwhelming vote at an election called for the purpose, favored a bond issue to finance the project. The initial $2,700 000 bonds of the district are secured by a total property value of more than $83,000,000.

FOR MANY years it has been the hope of settlers of the Snake River Valley that the building of this project would some day be consummated. The undertaking has been surrounded by obstacles that seemed insurmountable. But these sturdy men and women never lost faith.

Shortage of water upon smaller projects in the valley, followed by several seasons of drouth, stimulated the desire for additional water storage. These same people are now viewing the near-realization of their fondest hopes. Figuratively, it is a case of supplanting the sage with the rose.

After investigations and surveys it was found that the most feasible location for this great reservoir included the site occupied by the thriving town of American Falls. This problem seemed easy of solution compared with other obstacles that for years confronted the resolute settlers.

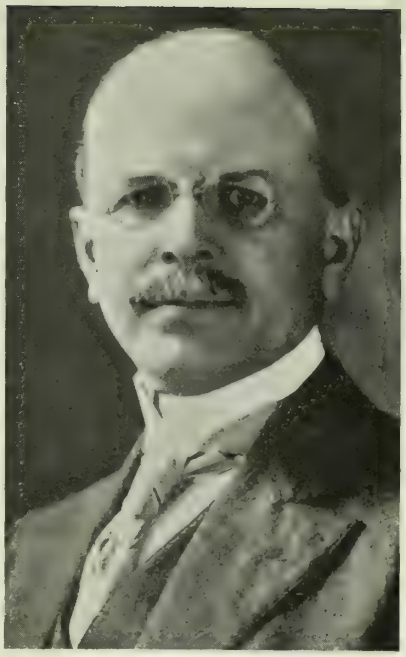
A new townsite was selected, on which has been planned a beautiful modern city. The old townsite, as part of the dam, will be completely inundated with water.

The American Falls reservoir district is a municipal, or quasimunicipal organization, created under the provisions of the Idaho irrigation district laws. Comprised in this one district are more than 400,000 acres of land situated in the Snake River Valley, the district controlling the existing irrigation systems between Idaho Falls and King Hill.

PRIOR to the organization of this district, extensive investigations were carried on by various irrigation companies, the State of Idaho, and the Bureau of Reclamation, looking to the construction of additional storage facilities for the regulation of the Snake River flow in the interest of irrigation.

As a result of these studies it was found that the American Falls reservoir site was the most advantageous of any of the sites in the watershed.

In order to co-ordinate the various interests seeking additional water, and to facilitate the construction of this reservoir, the Reclamation Service has, under authority of Congress, entered into



ADDISON T. SMITH

contracts with the various irrigation districts in the Snake River Valley in which it undertakes to construct a reservoir at American Falls for the joint use and benefit of the several districts and the Government's proposed Minidoka extension project, covering approximately 115,000 acres of undeveloped land.

Prior to May, 1923, the Federal Government had expended about $500,000 on the enterprise, and virtually no funds had been contributed by private interests.

There are probably 15,000 acres of new irrigable land within the trading radius of American Falls. These, if developed to capacity, would involve a maximum influx of urban population of from 1500 to 2000 people.

IT WILL probably develop, eventually, that the greater part of the irrigable lands in the vicinity of American Falls will be given over to the intensive production of potatoes, and the necessary alternating crops.

The soil of Southern Idaho is so well adapted to the prolific growing of sugar beets that every effort should be made to stimulate interest in this line of agricultural endeavor, especially as this country produces only about one-fifth the sugar consumed by its large population.

In the opinion of the writer the time is not far distant when capital in abundance will be seeking investment in the beet-sugar industry of the West; and with the completion of the American Falls dam, providing ideal conditions for the growing of sugar beets, Southern Idaho will take her place among the big sugar producing areas of the country.

The EDITORIAL

MODERN Irrigation

An Organized Voice for the Forces of Agriculture and Industry Which are Primarily Dependent upon Irrigation.

Published Once a Month

AT LOS ANGELES, CALIFORNIA, BY THE

PETROLEUM WORLD PUBLISHING CO. *Editorial and Executive Offices, 626 South Spring Street, Telephone Broadway 3262.* Branches: SAN FRANCISCO—447 SUTTER STREET, *Telephone Garfield 2772;* H. E. TAYLOR, *Manager.* CHICAGO—1163 MONADNOCK BLDG., *Telephone Wabash 8855;* JOSEPH E. O'CONNOR, *Manager.* NEW YORK—503 FIFTH AVENUE, ROOM 308, *Telephone Vanderbilt 8753;* WERNER HAUPTLI, *Manager.*

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By Annual Subscription in the United States and possessions, $2.00; Foreign, $2.50; Single copies on sale in the irrigation country, 20 cents. In ordering change of address, give both the old and the new address. Allow ten days for re-entries on the subscription list. Advertising rates and circulation data upon request. Checks should be made payable to Petroleum World Publishing Co.

VOL. II FEBRUARY, 1926 No. 2

The Scientific Spirit

THE OBSERVER of the water development industry, through its several divisions, can not fail to be struck by a distinctive characteristic. To a degree shared by few fields of commercial and industrial endeavor, the men concerned in the development and application of water supplies have a consciousness that they are involved in problems and responsibilities far more significant than the individual and his day's work.

In medicine, the same spirit is traditional. The physician studies the problems of disease in the distant ends of the earth, and follows the scientific advances of his profession, not for what such knowledge will bring to him, but for what use he can make out of it in behalf of the sufferers whom he attends.

In most of the sciences, the same attitude of progress, and of common concern in the problems and achievements of the profession, is apparent; but in most businesses it is not apparent. The financier studies the political and economic disturbances of the remote places, and makes note of the trivial things which may develop into significant factors in finance, it is true; but his motive is usually a selfish one. In irrigation, there is a general unselfish desire to learn about the interests, problems, failures and victories, of irrigation and hydraulic development in all parts of the country.

The Texan reads of the onward march of hydraulics in Idaho. The Californian reads of Colorado's progress. The Oregonian reads of great plans for development in Mexico.

So the irrigation industry, with its fundamental basis in a common task, is welded together. The advances of one section are made the achievements of all. The problem of a single part becomes the concern of all.

The Broad Outlook

Perhaps the explanation for the prevalence of this broad vision that goes beyond the limits of the particular task and the single organization, and takes in the larger aspects of water development, has its basis in the fact that the industry is technically based on an engineering science, and that all of its phases have thus come under the mental dominion of the engineer, whose education has trained him to relate the particular cog to the scope and purpose of the whole machine, and the particular function of the individual to the general problems of the whole industry. Or, possibly, it may be ascribed to the fact that water development is an outdoor profession, one that deals with the tangible and material stuff of nature; that the mind of the worker is irresistibly called back to origins and to primitive forces by the water that he brings from the mountains to the dam, and from the dam to the farm.

At any rate, whatever be the reason, it is a splendid and an inspiring thing that one may encounter in this industry. Each man has two concerns—the first, the day's work which he must discharge; the other, the general advance of the army of water development, whose movements he must note, with whose achievements he must keep pace, and whose problems he must understand and prepare to solve.

An Interesting Letter

AN interesting letter has come to the editor's desk. It is an invitation, addressed to MODERN IRRIGATION, for a representative of the magazine to attend a meeting of irrigation and hydraulic engineers, to speak to them about the plans and purposes of the publication.

"It occurred to me," says the writer of the letter, "that it would be interesting to this body to hear a short talk from you or some other representative of your magazine on the aims and purposes of your publication, and a statement on how you propose to meet the needs of the irrigation industry."

This letter is an expression of exactly that spirit of broad-view interest to which reference has been made. It is, of course, gratifying to the publishers of MODERN IRRIGATION that an organization of technical men should be desirous of hearing a statement of the pur-

POINT *Of* VIEW

poses of the magazine, but it is especially inspiring to realize that MODERN IRRIGATION has cast its lot in an industry where such a spirit is the rule rather than the exception—where men have a desire to know of the broad problems of the industry, and how they may be met.

Meeting Irrigation's Needs

ONE thought expressed by the writer of this letter may justify a brief additional comment. He is interested, he declares, in "how MODERN IRRIGATION proposes to meet the needs of the irrigation industry."

This magazine, of course, does not "propose to meet the needs of the irrigation industry," in the sense of prescribing for it a cureal that will overcome all its difficulties and banish all its ailments. If this body of engineers or any other organization that looks to MODERN IRRIGATION as a hopeful factor in the industry, expects it to expound some recondite formula in which may be found the secret for curing all the ills that irrigation flesh is heir to, it will be disappointed.

We do, however, conceive that the eventual working out of these needs of the irrigation industry may be immensely facilitated and expedited by such a magazine as MODERN IRRIGATION. The only organization capable of meeting the industry's needs exists within the industry itself, not in any outside source—neither legislation, nor journalism, nor government direction, nor experimental research, although all these things may contribute toward that end.

The function of such a publication as this is chiefly to place before the industry the means of self-expression in an organ that is to be peculiarly and exclusively the industry's own.

Is Reclamation Pork?

THE esteemed WORLD'S WORK, which has been quoted in this publication as a national magazine that realizes the importance of reclamation as a national issue, pays its respects to reclamation in the February issue in strong language. After pointing out that there are 6,000 reclamation project farms calling in vain for settlers, and that, at the same time, the Reclamation Service is "being bedeviled to construct several new projects," the magazine, in its editorial interpretation of the "March of Events" declares:

"The reclamation idea has fallen from its high estate of a piece of national statesmanship, of building new communities as new lands and their products are needed, to the low level of political pork, after the pattern of the old river and harbor bills. New lands are not needed at this time, the products of irrigated regions are temporarily a drug on the market, no settlers are crying for lands to buy. The only excuse for present extension of reclamation projects is that local interests need the money."

There may be some truth in what the magazine has to say, but, on the other hand, this brief editorial summing up of the situation is guilty of a fault too often to be descried in utterances prepared in New York editorial offices, several thousand miles from reclamation. Its origin is in a hasty generalization. Reclamation is too complex a matter to be measured by a foot-rule, or briefly dismissed in a column. "A reclamation problem," as such, has no existence. Reclamation presents a countless number of individual problems, with a different basis for each one.

Every project is a general grouping of smaller cases, not a case in itself. The individual ranch and the individual settlers must have individual consideration if we are to arrive at a proper understanding of their difficulties.

When the WORLD'S WORK tosses all reclamation expansion aside with a wave of its hand and says: "New lands are not needed at this time," it is assuming the dangerous prerogative of speaking in general and didactic terms for all the western states, with their great diversity of conditions, variety of products, and differences in experiences with reclamation. The matter may not be dealt with in that way.

The fact that reclamation is just this sort of a complex of varied problems is the prime factor in making it such a difficult matter to deal with. It is this fact, too, that gives the greatest force to the arguments of those who plead for a degree of decentralization not possible under the present system, and a share in control and responsibility by the individual states in which reclamation works are located.

A Reminder of a Debt

UNDER the lofty roof of an immense structure permanently devoted to this purpose, the Sixteenth National Orange Show, at San Bernardino, California, is in session from February 18 to 28th.

The gleaming piles of red-gold fruit, symbolic of the riches of Southern California, will bring home to tens of thousands of visitors their annual message of the bountiful endowments of this favored country, and how well these natural resources have been exploited.

How many of those who visit the Orange Show to admire the displays of "golden apples" will cast their imagination a step behind the glossy-leaved trees which bear the citrus fruit and see the dry, unproductive, sage-covered land that without irrigation could produce no fruit but a spiny cactus apple? The orange show, like any agricultural exhibit in the west, forms, for the thinking man, a monument to irrigation.

Fifteen million pieces of fruit, according to publicity matter circulated by the Orange Show, will be used in making the citrus displays. Fifteen million more evidences of the primary and fundamental value of irrigation!

Equipment Men Plan Service Program for Industry

Publicity and Educational Effort Have Big Place in Year's Work of Association

By HUGH CRANE

GATHERING in Los Angeles in the first business session of 1926, the Western Irrigation Equipment Association, in its January meeting, mapped out for itself a definite program of accomplishment for the year which, if followed out, will amply justify the association's purpose to be known as a real service organization for the industry.

The executive committee meeting on the morning of January 22, followed by the open meeting of the membership in the afternoon, and a banquet in the evening where business matters were forgotten and joy reigned unrefined, comprised a regular session of more than ordinary activity.

PUBLICITY and education are two new fields of endeavor to be entered by the Western Irrigation Equipment Association in 1926.

Under the leadership of C. B. Noyes, of the Sierra Machine Company, who heads the publicity committee, a publicity campaign is to be worked out that will make available through many sources the most valuable and accurate information on irrigation practices of the sort in which the association is interested.

Newspaper publicity, paid advertising space, the contribution of articles to technical journals, and other similar channels will be used in this effort. A monthly department in MODERN IRRIGATION, which has been designated the official publication of the association, is being considered. It is planned, also, to make the name and purposes of the organization better known by the adoption of an official trade-mark to be used on all literature issued by the W. I. E. A., and to be incorporated into an attractive lapel button for the use of members.

Envelope stuffers for the use of members in correspondence, the imprint of the association on members' letterheads, and all such methods of promotion will be consistently encouraged. Another constructive and helpful part of the publicity campaign will be the preparation of an improved and revised Data Book, on which a committee is now actively at work.

Schools, fairs and exhibits, bankers' organizations and farm bureaus will be used in the education campaign of the association. A course in farm hydraulics will be urged for inclusion in the high school curriculum, and catalogues and bulletins issued by the association and its members will be made available in high school libraries. Through co-operation with the state board of education and individual schools and teachers, it is expected that the association may obtain a degree of emphasis on an important phase of agricultural education that has never in the past been approached.

The close connection between irrigation and finance will be taken advantage of, by making direct appeals to bankers' meetings, both locally, and in state and regional conventions. The purpose of this effort will be not merely to encourage a mutual knowledge of problems between the bankers and the equipment manufacturers and dealers, but to facilitate some form of practical co-operation in financing the purchase of irrigation equipment.

Through farm bureaus, a valuable contact with the individual user of equipment is at hand, and will be employed wherever possible, members of the association speaking at farm centers on technical and financial subjects connected with irrigation pumping.

The association will continue its efforts to secure adequate representation at fairs, and wherever practical will have literature for distribution at such exhibits, will maintain a helpful information bureau, and will conduct an irrigation display calculated to attract and hold the attention of the crowds.

SEVERAL important matters remain to be decided by the Association. The complex and difficult job of adopting a standard pumping inquiry and guarantee form has made progress, but has not yet been completed. Professor L. J. Fletcher, of the Agricultural Engineering Division of the University of California, attended the meeting and reported on this subject.

Another live issue before the organization is the question of whether or not pumps should be sold by manufacturers, or retailed exclusively through dealers. There will be keen interest in the discussion of this subject at the April meeting of the organization, to be held in Fresno.

According to a change in the constitution, adopted at the January session, the presidency of the W. I. E. A. is now a job of limited tenure, the new amendment providing that the President may hold office for one year only and shall not succeed himself.

C. F. ZIMANSKY

President, Western Irrigation Equipment Association.

MEMBERS of the association are looking forward with anticipation to the Fresno meeting, which will be held on Friday, April 16, in the building of the San Joaquin Light and Power Company, with A. M. Frost, salesmanager of the company, as chairman of the committee on arrangements.

An enjoyable feature of the January meeting was the banquet, at which informal and unprogrammed speeches were heard from many of the members in attendance. Frank P. O'Brien, of the industrial department of the Los Angeles Chamber of Commerce, was the speaker, tracing the industrial growth of the southwest in a convincing manner. Douglas G. McPhee, editor of MODERN IRRIGATION, served extemporaneously as toastmaster, and in addition to presiding gracefully over the speech-making, delivered an impromptu address of his own, telling the association members of the purposes and plans of the magazine which they recently designated as their own official publication.

Owen Brown, co-publisher of MODERN IRRIGATION, and the first honorary member of the W. I. E. A., was present and responded briefly but appropriately to his introduction to the organization.

Joseph H. Cox, J. E. Lundy, W. P. Custer, C. B. Noyes and others also responded extemporaneously with a smile and a cordial word when called upon by the toast-master.

THE HYDRAULIC DIGEST

A Monthly Bulletin Board of Brief Facts and Events from Far and Near

Revised Budget Adopted

The revised budget for 1926 adopted by the Imperial Irrigation District involves an expenditure of $2,904,050 during the year. The contemplated total is less by $98,634 than the actual total expenditures in 1924.

Tacoma Takes Over System

The city of Tacoma, Washington, has acquired, for a consideration of $50,000, the holdings and franchise of the North End Water Company. This transaction gives the city complete control of the service of water to the community.

Banta-Carbona Completed

The construction of the Banta-Carbona Irrigation District, near Tracy, California, was completed in February. Completion of the project brings 14,150 acres, practically all of which are cultivated, under irrigation. The cost of the project has been $820,000.

Use Planes in Survey

A valuation survey of the property of the Consolidated Water Company, of Pomona, California, including its mountain watershed, will be aided by the use of government airplanes, it has been announced by Seller & Latker, the engineering firm in charge of the valuation.

Exchequer Dam Complete Soon

The Exchequer dam and the large construction works which it has entailed will be completed on April 1, according to the report early in February to the directors of the Merced Irrigation District by R. V. Meikle, chief engineer.

Laguna Votes Bonds

Matching and surpassing its previous unanimous vote for the formation of a water district, Laguna Beach (California) set a new mark to shoot at in January when it recorded another unanimous vote in favor of issuing $600,000 in water bonds. The earlier vote in favor of forming a district was 359 to 0. The vote in favor of the bonds was 437 to 0.

Push Columbia Basin Project

Plans for Congressional approval of the Columbia River Basin project have not been abandoned, but are being vigorously pushed at Washington by officials of the Columbia Basin Irrigation League, who are hoping to arrange hearings before the senate committee on irrigation and reclamation.

New California District

A new irrigation district in Napa and Solano Counties (Calif.) is contemplated by an application filed with the state Division of Water Rights by W. S. Davisson, of Suisun, asking permit to appropriate 200 cubic feet a second and 10,000 acre feet a year from Suisun Creek, tributary to Suisun Bay.

Add Three Miles of Levees

Directors of the Imperial Irrigation District have authorized the extension of the present levee system of the district by three miles, along the west side of the Pescadero cut. The estimated cost of the work is $40,000 to $50,000, half of which is to be paid by the Colorado River Land Company.

Oceanside Plans Reservoir

The city of Oceanside, California, is planning to construct a three-million-gallon water storage reservoir, to serve 2000 acres recently added to the corporate area of the city. The present capacity of the reservoirs serving the city is 600,000 gallons. The small ranches added to the city by the inclusion of the additional acreage required the extra storage.

Irrigation Districts Body Meets at Merced March 11

The Irrigation Districts Association of California will hold its annual meeting at Merced on March 11, according to the announcement of W. D. Wagner, its secretary. The program will include inspection of the new Exchequer Dam and other works of the district.

To Deepen Reservoir

The storage capacity of the Lake Hodges reservoir of the city of San Diego, California, will be increased by 4,000,000,000 gallons, according to plans completed by the city council. The plan provides for installation of 14 radial flash gates in the spillways, which will raise the water level to near the top of the dam. Estimated cost is $50,000.

Yakima Sells Water Bonds

Yakima, Washington, sold two water bond issues in January. One issue, general obligation bonds, were purchased at par ($450,000) by the state of Washington, at 4½ per cent interest; while the larger issue, $1,050,000 was taken at $95.70 with 5½ per cent interest by a Seattle syndicate comprised by Burr, Conrad & Broom, Inc., Ballairgeon, Winslow & Co., W. P. Harper & Son, and the Seattle National Bank.

$3,000,000 Washington Project

A temporary permit was issued in January by R. K. Tiffany, state Supervisor of Hydraulics of the state of Washington, to R. W. Lincoln, of Portland, Oregon, authorizing a $3,000,000 water project on Toutle River. The applicant represents the Spirit Lake Railway & Power Company, which, it is announced, plans to start immediately on the construction of a concrete arch-dam 600 feet long and 110 feet high.

Form Protective Body

The Santa Clara River Protective Association, in which irrigationists of the Santa Clara River of the South (Ventura County, California) are associated, is seeking official incorporation. The organization has been formed for the protection of the water rights of the owners of 100,000 acres of land in Ventura County, all of which is irrigated from the underflow of the Santa Clara River. The association hopes to treat with the city of Los Angeles or other interests desirous of appropriating waters of the river, for the purpose of protecting the present water supply of its membership.

Ask Investigation of Acts of Reclamation Bureau

Klamath Irrigation District (Oregon) has gone to Congress with its grievances against the federal Bureau of Reclamation. In a communication addressed to Senators McNary and Stanfield, and Representatives Sinnott and Raker, the district petitions for an investigation of certain acts and decision of the Bureau to which objection has been made.

The alleged acts which the district particularly wishes investigated, according to the communication, are:

1. A contract, which the district asserts to be against public interest and the avowed policy of the government, whereby the California Oregon Power Company has acquired use of water from a government reservoir without charge, "and control of the main source of water supply of the Klamath project for a period of 50 years."

2. Sale of two power canals to the same company "over the protest of the water users who owned or would own them, and for a vastly inadequate, a nominal compensation."

3. Alleged interference by the Bureau of Reclamation in the internal affairs of the district.

4. Asserted refusal to grant a moratorium on construction payments to the project after Congress had given authority for such action.

5. Alleged failure to allow the district the benefits of the Fact Finder Act.

6. Insertion of a clause in an operation and maintenance contract submitted by it to the district "which would, in effect, deprive the district of water rights of great value without compensation therefor."

7. The petition asks the privilege of showing the senate that the plans of the Reclamation Bureau will lose to the district at least 100,000 acres of its best land.

January Snowfall Records in Northwest Show Deficiency

Records of snowfall, received from various Pacific Coast points during January, indicated that the seasonal fall was considerably less than the normal at that time. At the beginning of the year the weather report issued by J. L. Lytel, superintendent for the United States Bureau of Reclamation at Yakima, Washington, estimated a snowfall of sixty-two per cent of normal over the entire watershed of that district. In Oregon, a similar condition is reported, with both rainfall and snowfall showing marked deficiencies.

Washington Irrigation Men Meet at Yakima

The Washington Irrigation Institute met at Yakima, Washington, on February 10 and 11, with state and national leaders of irrigation in attendance. A representative of the Bureau of Reclamation met with the Institute and discussed matters in which Washington, the state, and Washington, the federal capitol, are mutually interested. Senator D. V. Morthland and Representative Mark Moulton discussed state and federal reclamation policies, and irrigation experts spoke on various phases of irrigation management and financing.

Central Oregon District Reduces Obligations

Farm produce from the Central Oregon Irrigation District in 1925 amounted in gross value to $1,700,000, or approximately $59 per acre. The district, which includes an irrigable area of 45,497 acres, has reduced its indebtedness to approximately $4.00 per acre, and this is being gradually reduced. The district was organized in 1917, with 1200 land owners on the project. Its total bonded indebtedness amounts to $180,000, compared with an estimated farm value of more than three million dollars.

Conserving and Controlling Western Waters

(*Continued from Page 15*)

relatively lighter tasks in western irrigation reclamation have been very largely accomplished, however, and with some of the big water conservation projects of the future sure to bring on costly reconstructions and rearrangements of systems in accordance with comprehensive plans, direct public aid of a larger order of magnitude seems inevitable.

For example, the State Department of Public Works of California is now engaged in an investigation of the water resources of that State with a view to developing plans for their complete economic utilization. It is a foregone conclusion that some of the works that will be required will be of the nature of great public improvements for which the lands specifically benefited can not pay. Of a somewhat different order are the proposed great Columbia Basin project in Washington and the extensive works that will be involved in any development of the Colorado.

NO LACK on our part of proper irrigation and reclamation management can alone justify a call for increased public financial aid. Certainly such increased aid is not likely so long as the excessive costs to the farmer are due to land speculation or to inefficiency on our part in meeting the problems of settlement. But when, after some fair solution of our settlement problems has been effected, more irrigated or reclaimed land is needed and the farmer still can not earn the entire cost of reclamation, justification for increased public aid will be found in the general public benefits that will accrue from the reclamation, just as it has in numerous other countries.

In the case of such reorganizations and rearrangements as will be required in substituting comprehensive developments of entire stream systems or combinations of stream systems public aid is justified on the further ground that Society must pay for the mistakes of Society, or for the more costly of the changing conditions that render what is economic in one generation uneconomic in a later one.

Heretofore we have considered public aid in reclamation almost wholly as a Federal function, the only important exceptions being the three states extending assistance to irrigation, drainage, and reclamation district already mentioned. As a closing thought on this subject the suggestion is ventured that states financially able to help, and in which help is or will be needed, will in due time be giving careful consideration to their responsibility, for it is a rather well established principle that, in general, the Federal function is to do what the States can not. Perhaps our own chief function in the matter is, within our respective states, to stimulate thought on this subject that has a State-wide viewpoint.

Water Survey Report Ordered by San Francisco Mayor

Mayor James Rolph, Jr., of San Francisco, upon the receipt of a letter, during January, from the city health officer, warning, in gravest terms, of an impending water shortage, instructed City Engineer M. M. O'Shaunessy to make an immediate report on the water situation of the city. The letter of the health officer called the Mayor's attention to the fact that "San Francisco is facing a shortage of water, and no assurances, excepting heavy rainfall for the remainder of the season, can eliminate a grave menace to the public health."

Three steps were urged to be taken to remedy the shortage; wells to be sunk in the Richmond district; waste of water in sewers and street flushing to be discontinued, and substitution of salt water for fresh water in the fire-fighting system.

LAYKOLD
EMULSIFIED ASPHALT
TRADE MARK REG

Government Reports of an unusually light snowfall in the mountains indicate a serious shortage of water for irrigation use this summer. There has been little snowfall and it is too late now for the snow to pack sufficiently to insure a normal supply of water.

Since this is the case, it will be to the advantage of every district and individual to investigate now the matter of lining or relining ditches that have been wasting water in the past.

We have a message of interest to the entire irrigation industry. In later letters we will tell you more of our ditch-lining process—how rapidly it can be applied—how economical it is—how it conserves water, reclaims land, and saves crops.

But for the present we must center all of our attention on those who will need assistance & advice in their lining problems between now and the time when the water must be turned in.

From them we invite immediate correspondence, with the promise of an intelligent assistance based on a knowledge of their problems.

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MANAGEMENT

STORING WATER FOR DOMESTIC USE ON THE FARM*

WATER for domestic use on the farm may be stored in wood, steel, or masonry tanks, and to secure gravity delivery the tank must be elevated above all faucets. Tanks placed in attics, barn lofts, and upon light trestles are unsatisfactory. The objections relate to insecurity and leakage, lack of pressure, and unwholesomeness in summer and freezing in winter. Masonry tanks may be placed on a hill, silo, or masonry tower. Where possible, an underground concrete tank on a hill is very desirable, avoiding trouble with frost and giving a tempered and sure supply.

Tanks should hold more than one day's supply. For windmill supplies the requirements of a week or more may be needed at times. Tanks should be provided with a waste pipe and valve to facilitate emptying and cleaning, and without fail should be covered tightly for protection against heat, cold, dust, vermin, and sunlight. Where exposed to light, ground and filtered waters are liable to develop growths which impart objectionable odor, taste, or appearance.

Water may be stored and delivered to the faucet by use of a hydro-pneumatic (water-air) tank. The tank need not be elevated and usually is conveniently located in a utility room, basement, or cellar. Hydro-pneumatic tanks must be absolutely air-tight. Air, being lighter than water, occupies the upper portion of the tank, and it presses with increasing force against the water as either more water or more air is pumped into the tank. When air and water are under pressure the latter gradually absorbs the former, and this absorption is the more rapid the higher the pressure. From time to time, therefore, the air supply must be replenished, or the tank becomes water-logged.

Maintenance of the air supply is a vital factor. Inlet and outlet pipes must enter at the bottom of the tank. Hydro-pneumatic tanks are made of three-sixteenths inch or thicker steel with riveted and welded or calked joints. A range boiler or other thin-walled tank should not be used for this purpose. The smaller tanks generally are galvanized and may be set vertically or horizontally; the larger tanks are set horizontally.

TO OBTAIN the best service from a hydro-pneumatic tank it is necessary to carry an initial or excess air pressure; that is, enough air to give pressure when no water is in the tank. Table 1 shows what percentage, or fractional part, of any tank, either vertically or horizontally set, contains water under varying condition of gage pressure and initial air pressure.

tank is from one-fourth to one-third of its total capacity.

The farmer should outline his plans for the various parts of his system. Suppose a plant is desired to meet the needs of 5 persons, 25 cattle (including horses or mules), 50 sheep, and 50 hogs. The average daily requirements would be as follows:

	Gallons
5 persons at 40 gallons each	200
25 cattle at 12 gallons each	300
50 sheep at 1 gallon each	50
50 hogs at 1 gallon each	50
Total	600

TABLE 1

Quantity of water in fractional part of total capacity of any hydro-pneumatic tank (based on atmospheric pressure of 14.7 pounds to square inch):

Gage pressure (lbs.)	Initial air pressure in lbs. 0	5	10	15	20	25	Gage pressure (lbs.)	Initial air pressure in lbs. 0	5	10	15	20	25
5	0.25	....	....	....	....	....	45	0.75	0.67	0.59	0.50	0.42	0.34
10	.40	0.20	....	....	....	....	50	.77	.70	.62	.54	.46	.39
15	.51	.34	0.17	....	....	....	55	.79	.72	.65	.57	.50	.43
20	.58	.43	.29	.14	....	....	60	.80	.74	.67	.60	.54	.47
25	.63	.50	.38	.25	.13	....	65	.82	.75	.69	.63	.56	.50
30	.67	.56	.45	.34	.22	0.11	70	.83	.77	.71	.65	.59	.53
35	.70	.60	.50	.40	.30	.20	75	.84	.78	.72	.67	.61	.56
40	.73	.64	.55	.46	.37	.27	80	.85	.79	.74	.69	.63	.58

Table 1 has many uses. It shows that if water is pumped into a tank, having no pressure above that of the atmosphere, until the gage shows 5 pounds, the tank will be one-fourth (0.25) filled with water; at 15 pounds it will be about one-half (0.51) full; at 30 pounds it will be two-thirds (0.67) full; at 45 pounds it will be three-fourths (0.75) full; at 60 pounds it will be four-fifths (0.80) full.

An example will be helpful: Suppose a 200-gallon tank is half full of water under a gage pressure of 45 pounds, and it is desired to know what quantity can be drawn before the pressure reaches 25 pounds. Inspection of Table 1 shows that if half (0.50) full at 45 pounds the initial air pressure must be 15 pounds, and under that excess a tank is one-fourth (0.25) full at 25 pounds gage pressure. Therefore, 0.50 minus 0.25 equals 0.25, which, multiplied by 220, equals 55 gallons, the available quantity. In general the working capacity of a

A suction pump would be used with a shallow supply; a deep-well pump or set-length pump would be used with a deep supply. A suction pump probably would be located in a dry, frost-proof basement, pump house, pit, or underground concrete chamber opening into the house cellar. A deep-well pump probably would be outside of main buildings; if a pit or chamber, there should be a manhole over the center of the well to permit pulling up the pump rod and drop pipe.

TO DO the day's pumping in two hours would require a pump having a capacity of 300 gallons per hour or 5 gallons per minute. The more constant the power, the more reliable the equipment, and the more accessible the repair parts the less is the need of large water storage. An automatic electric-driven pump may have a pressure tank varying in capacity from 10 gallons upward. It would be arranged to start

*Reprinted from Bulletin 1448, U. S. Department of Agriculture, entitled "Farmstead Water Supply."

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pumping when the pressure falls to 25 or 30 pounds. With very small tanks any considerable use of water starts the pump and delivers water by direct pump pressure.

The smaller pumps and tanks are especially useful for cistern and other household supplies, but the pump capacity (5 gallons per minute) figured in the example, would give fair discharge from one garden hose nozzle or two ordinary spray nozzles or two house faucets. Faster use of water would require a larger tank; a tank 30 inches in diameter by 6 feet long, 220 gallons capacity (water and air) should be sufficient for short heavy drafts, having a working capacity of approximately 50 gallons (oil barrel capacity) between the usual stopping and starting pressures noted above. If electric current cost 15 cents per kilowatt-hour the cost of pumping 600 gallons would approximate 14 cents per day.

A larger tank would be used if the pump were not automatic or were engine-driven. Under those circumstances a hydro-pneumatic tank 42 inches in diameter and 14 feet long, 1,000 gallons total capacity would be suitable. With 20 pounds initial air pressure, it would deliver 290 gallons between pressures 45 and 25 pounds. (See Table 1: 0.42 minus 0.13 equals 0.29, which, multiplied by 1,000, equals 290 gallons.) Hence it would be necessary to operate the pump twice a day. If an elevated tank were to be employed its capacity should be larger.

Three New Members for Advisory Board

(*Continued from Page 18*)

Health Service in Idaho from 1919 to 1925, in addition to his state duties.

W. L. Powers

W. L. Powers, Chief in Soils at the Oregon State Agricultural College, is a man who combines in rare measure the broad-view attitude of the academician, the scientific spirit of the research authority, and the practical knowledge and skill of the man who is in daily contact with the realities of irrigation problems.

He has been familiar with agricultural matters since boyhood, having grown up, as so many "westerners" have done, on a farm in the Middle West, and having come to the far-west to devote himself to the study of agricultural conditions on the Pacific Coast. His youth was spent in northern Illinois, and most of his undergraduate college work was done at the University of Illinois.

After his graduation Professor Powers spent two years with the New Mexico

Experiment Station, meeting the problems of agriculture on arid lands at first hand, and putting into practice some of the knowledge which his academic education had given him. His work was in irrigation and soil investigations. In 1909 he was called to Oregon and since that time has been with the Oregon Agricultural College at Corvallis. His work is in the Experiment Station, where he is contributing much to the knowledge and literature of his subject. He has published about twelve Experiment Station Bulletins dealing with reclamation, and a text book on Land Drainage. At the present time he is secretary of the Oregon Reclamation Congress and of the Oregon Drainage Congress, in both of which organizations his ability counts as a wise and constructive force. He is now a candidate for the Ph. D. degree at the University of California.

G. E. P. Smith

Another University man and research scientist whose practical achievements in irrigation have earned him the respect of the industry is G. E. P. Smith, irrigation engineer at the University of Arizona. Professor Smith was graduated from the University of Vermont in 1897, receiving the highly valued Phelps prize, and two years later received the degree of C. E. He was retained at that institution for three years as instructor in the engineering department. In 1900 he came to the University of Arizona, where he is now serving his twenty-sixth year. His more than a quarter century of service has seen epochal transitions in his adopted state, and in irrigation practices there and elsewhere, but probably no Arizonan has contributed more to the advance of successful irrigation than he. Since 1906, he has been professor of irrigation engineering and irrigation engineer of the Agricultural Experiment Station of the University.

Professor Smith has had various engineering connections and in later years has done consulting work, especially in irrigation lines. His investigations have included studies of groundwater supplies, the loss of groundwater by transpiration, caisson wells, pumping for irrigation, concrete pipe, and Colorado River problems. He is the author of a large number of bulletins and contributions to the technical press.

The development of pump irrigation in Arizona to its present status has been due in no small measure to his leadership. He is a member of the American Society of Civil Engineers, the American Association of Engineers, and is a fellow of the American Association for the Advancement of Science.

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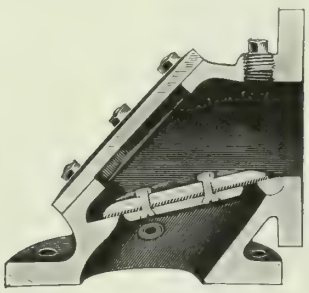

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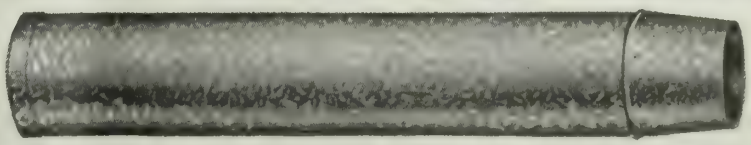

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HYDRAULIC ENGINEERING

Dealing with the Practical Problems of the Operating and the Consulting Engineer

INTERPRETING ENGINEERING AS A FINE ART

"ENGINEERING a great project such as the Kings River Development is very much like writing a novel or play, painting a fine picture, or carving a great statue," says Sidney Green, in San Joaquin Power Magazine, of Fresno, California. The writer then goes on to show how the qualities demanded in the engineering of a great hydraulic project are essentially the same as those required by the artist.

The hydrographer making his rounds, measuring next summer's irrigation water, at an elevation of 8,000 feet, overlooking the west fork of King's River.

Back of all masterpieces in art and literature is the basic idea, the purpose of the work. Before the actual building of the work begins there must be gathered vast quantities of detail,—the result of research and observation by the creator. Facts and information must be assembled; speculation demanding imagination and judgment must be used to determine results in the event certain things are done. All must be thought out, revised, corrected and changed until the creator is satisfied that the work is what he wants.

The printing of a book, the presentation of a play, or the reproduction of a statue, call for skill and art on the part of the printer, artist, actor and sculptor, just as the machine-like precision with which a great engineering project moves forward calls for skill, experience and no small amount of courage on the part of the construction engineer.

The groundwork or general picture of the Kings River Development was long ago roughly sketched by Mr. A. G. Wishon, president of the San Joaquin Light and Power Corporation and his pioneering engineering parties. The direction of the streams and approximate head, or fall of water, were carefully mapped, contours of the country were studied, watersheds inspected, trails built and reconnoissance surveys made. Engineers were placed in the high country along various streams to measure the snowfall and streamflow. These hydrographic studies have brought out some interesting information on the amount of water available, and the records are not yet completed. All these data were raw material to be used by the designing engineers. It is from this mass of facts and figures, and from estimates, where definite information was not obtainable, that the size and location of reservoir sites, dams, tunnels and power houses are determined.

The "Snow Thief." Not the man—the instrument. Photographs illustrate weighing contents, inserting snow thief, and melting snow over a fire.

To measure the flow of a stream may appear a simple matter. But the measurement of streams that vary in depth from a few inches to twenty or thirty feet, streams that are solid ice in the winter and raging torrents in the spring, is a work that requires men of courage and daring,

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Direct reading; all parts accessible; operation easy to understand. Can be mounted at any angle.

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Simple in construction with few complicated parts reduces the manufacturing and makes possible low selling price.

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WELL CASING

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All Sizes

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P.O.Box 37
Arcade Station
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California

men specially trained to make the observations. These men are known as hydrographers.

Preparations for a season's hydrographic work begin in August when supplies are packed in to the various cabins where the men make their winter headquarters. Five cabins were constructed and equipped with accommodations for the men. The headquarters cabin was at Cliff Bridge, 16 miles from Dinkey. Other cabins were at Buck Meadow, Sand Meadow, and Hobblers, while the most remote cabin was at Meadowbrook, 23 miles from Dinkey.

The supplies are locked in strong wooden boxes lined with sheet metal, and bear proof. Potatoes are buried below the frost line, while in the lower altitudes eggs are wrapped in mattresses. In the higher altitudes eggs, meat and vegetables are permitted to freeze about November 1 and remain frozen until April or May. Barbed wire is nailed across the windows to keep out the bears.

The men usually work in pairs starting their first regular round of inspection of the gauging stations before the first snow falls. Each recording station is visited, boxes are inspected and recording instruments are carefully gone over to see that they are ready to take accurate measurements.

Eight feet of snow, says this gauge.

A stream flow gauging station consists of a recorder well of stone or concrete, 3 by 4 feet, built on bed rock on the bank near the deepest portion of the stream. The water enters the gauging well by an intake pipe 4 inches in diameter extending to the deepest part of the stream. In the well is a Stevens automatic recording gauge showing the depth of the water. Eight of these stations are located on the streams under observation. Streams above 8,000 feet elevation freeze solid during the winter months. Snow measurements are made after each snowfall at points typical of the country at various elevations. For this work a "snow thief" or tube is inserted into the snow to the earth or rock and the contents of the tube weighed or measured to determine its density.

About April 15 the runoff starts. Under the warming spring sun small streams begin to trickle down the mountain sides. These streams usually freeze during the night but gather force each succeeding day until during May and June the canyons become raging torrents and the snow and ice forms dams making great lakes on the meadows. The impounding dams burst causing floods that wash away bridges and put gauging stations out of commission. These are the times when the hydrographer is put to the acid test. All this runoff must be measured, and if a gauging station goes out he must improvise one at once. This improvised station may benothing more than a notched sapling driven into the bed of the stream near a protecting rock. Because it is not an automatic station it requires his constant observation to get the varying levels of the stream, from which he can later make his computations. It is not unusual for an observer to swim a stream to reach certain gauging stations during the heavy runoff. Every station must be inspected daily during these periods.

While hydrographers were making stream-flow and runoff studies, engineering parties were making reconnoissance surveys.

The reconnoissance survey men are the "goats" of the engineering profession. When the average city man sits comfortably in an automobile on a smooth roadway cut from the granite side of a canyon and looks up to the brink of the cliff and down to the stream 2,000 feet below he begins to have some idea of the daring and ability of the engineers who surveyed the route for this road. And when Mr. Cityman is told that the engineer who made these surveys found the country with nothing more passable than a deer trail,

he looks with respect at the wiry young chaps he sees packing a transit, rod and axe and nonchalantly making their way up a trail to "run a line," possibly over a mountain to indicate the course of a tunnel. Mountain goats turn green with envy at some of the feats these boys perform,—all in a day's work. They are the "S. I.'s," the civil engineers, who get the facts and figures upon which the designing engineer works out his problems.

Kings River Project Approved by Power Commission

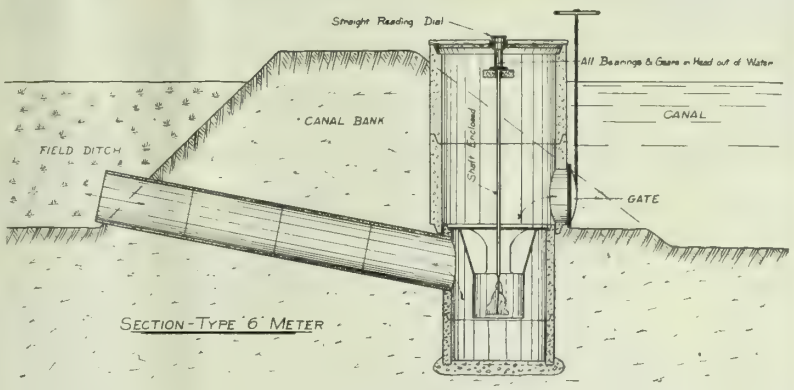
Development of North Fork Embraced in Amended License of San Joaquin Light & Power Co.

The Federal Power Commission, by action taken in January, has authorized amendment of the license issued to the San Joaquin Light & Power Corporation on July 28, 1922 for the project designated as No. 175 so as to include its developments on the Upper North Fork of Kings River, in California. The new works will consist of four dams known respectively as the Helms dam, the Upper North Fork diversion dam, the Fleming Creek diversion dam, and the Post Corral dam, two water conduits having a total length of about 10 miles, and a power house known as the Helms power house located near the upper end of Lake Wishon. The Helms dam will be a constant-angle-arch, concrete structure about 297 feet high, creating a reservoir of approximately 102,000 acre feet. The Upper North Fork diversion dam will be a rock-fill dam, with a total length of about 1,375 feet and a crest width of 12 feet. The Fleming Creek diversion dam will be a rock-fill dam 80 feet long and 15 feet high. The Post Corral dam will be a rock-fill structure, having a maximum height of about 66 feet and crest length of 985 feet. The power house installation will consist of three 13,600 Kva. generating sets, direct-connected to overhung-impulse turbines.

Lake Will Be Formed

An artificial lake, four miles long and a mile wide, will be formed if plans of the Montague Irrigation District in the Shasta Valley of Northern California are carried out. The lake will be stocked with game fish and surrounded by duck preserves and country homes, it is contemplated. Work has been begun, and the project is expected to be completed in 1927.

The RELIANCE METER



THE "Type 6" Reliance Irrigation Meter offers you standardized permanent construction at a very low first cost. Their sustained efficiency with a minimum of upkeep has been proven by 12 years usage. Cut shows installation of the 4 sec. ft. size in 24 and 30-inch concrete pipe. This is the standard type of setting adopted by many irrigation districts in Texas and elsewhere who are now equipping all their deliveries with this device. The "Type 6" meter is furnished in sizes ranging from ½ up to 16 sec. ft.

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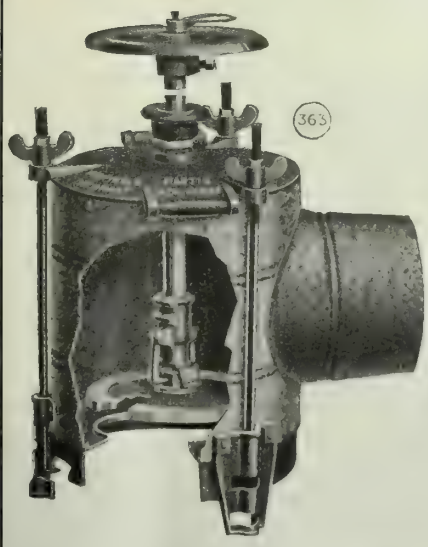

Martin engineers, specialists in utility irrigation appliances, never designed a more serviceable piece of equipment than the MARTIN PORTABLE HYDRANT. Its use with MARTIN Alfalfa Valves Type B and Type Q enables the irrigator to control the direction of flow easily. Four checks can be irrigated handily and the operator knows exactly the amount of water each check is getting.

The spout of the hydrant can be turned in any direction. Two hydrants are generally used on one pipe line. While one is set and operating, the other can be moved to the next valve and set up ready to operate. Surface pipe can be attached to hydrant before valve is opened. The valve is opened and closed by the wrench built into the hydrant. After the entire field is irrigated, the hydrants can be removed and placed in the tool house. As the Type B valve is flat on top, there are no obstructions in the field to catch the mower or rake.

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WITH THE WATER COMPANIES

Of Interest Expressly to Water Works Engineers, Superintendents and General Managers

HAVE YOU TRIED CEMENT LINING FOR CAST-IRON PIPE?

By A. P. LOVELL

Superintendent of Water, San Diego, Calif.

SINCE the first use of mountain water by the City of San Diego, (this water being what is termed an "active water" by water men) the city has been seriously bothered by tuberculation of its C. I. mains. This applies particularly to mains of low velocity, the higher velocity mains having apparently kept themselves clear.

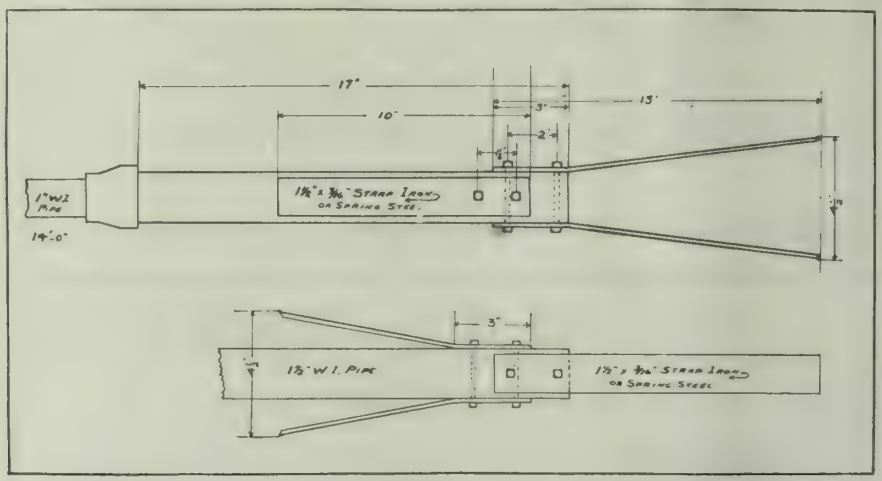


FIGURE 1.—The first step in Mr. Lovell's interesting experiments was the construction of a pipe-cleaner, as shown in this sketch.

Experiments have been made to prevent this tuberculation, from time to time, in a more or less desultory manner, with various pipe dips, but without avail.

Some months ago it was necessary to remove a 4-inch C. I. main and replace it, as the district served by this main was getting an inadequate amount of water. As it is now our policy to lay no mains smaller than six-inch in thickly settled districts, it was accordingly replaced with one of that size. The four-inch main had been in use about twenty-five years and externally was apparently in as good shape as the day it was laid. Investigation of the interior, however, proved it to be so badly tuberculated that it probably would not have delivered as much water as a new 1½-inch pipe. Had this main remained free of tubercles it would not have been necessary to replace it.

I had been watching with interest for several years past the experience of Charleston, S. C., with cement-lined pipe in combatting similar conditions, and decided to experiment with cement-lined pipe in San Diego.

Owing to the lack of funds for experimental purposes it was necessary to carry on our experiments with what tools and material were available in our own yards.

I derived a great deal of information from correspondence with the Pacific Coast representatives of the various cast iron pipe foundries, which now line their pipe with cement when so ordered; and from reading articles written by J. E. Gibson, manager and chief engineer of the Charleston (S. C.) Water Department.

WE FOUND that cement-lined pipe, wrought iron, had been in use in the New England states for some sixty or seventy years. The condition of the interior of this pipe, whose known age was at least thirty-nine years, was as good as or better than when laid while externally it was badly pitted. The pipe in question was from Danvers, Mass., and the same condition existed in a W. I. pipe twenty years old from the Norfolk, Va., water system.

As Mr. Gibson had made very exhaustive tests with calibrated instruments to determine the value of the coefficient "C" in the flow formula of Hazen and Williams, I will quote the result of a few of his tests as published by a large manufacturer of cast-iron pipe:

Date of Test—December, 1922			
Flow in 1000 Gals. per 24 hours	Vel. in Ft. per sec.	Loss of Head per 1000 Ft.	Value of "C" H and W
299.44	2.68	4.97	138
496.34	4.45	12.55	139

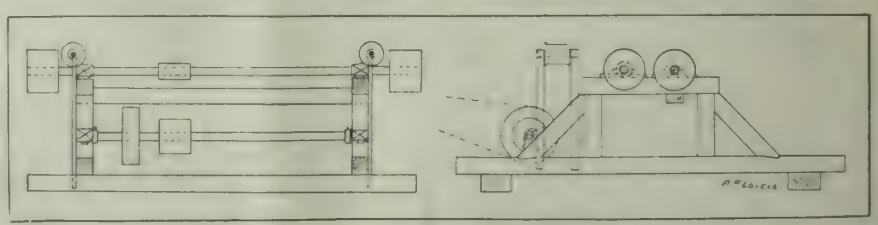
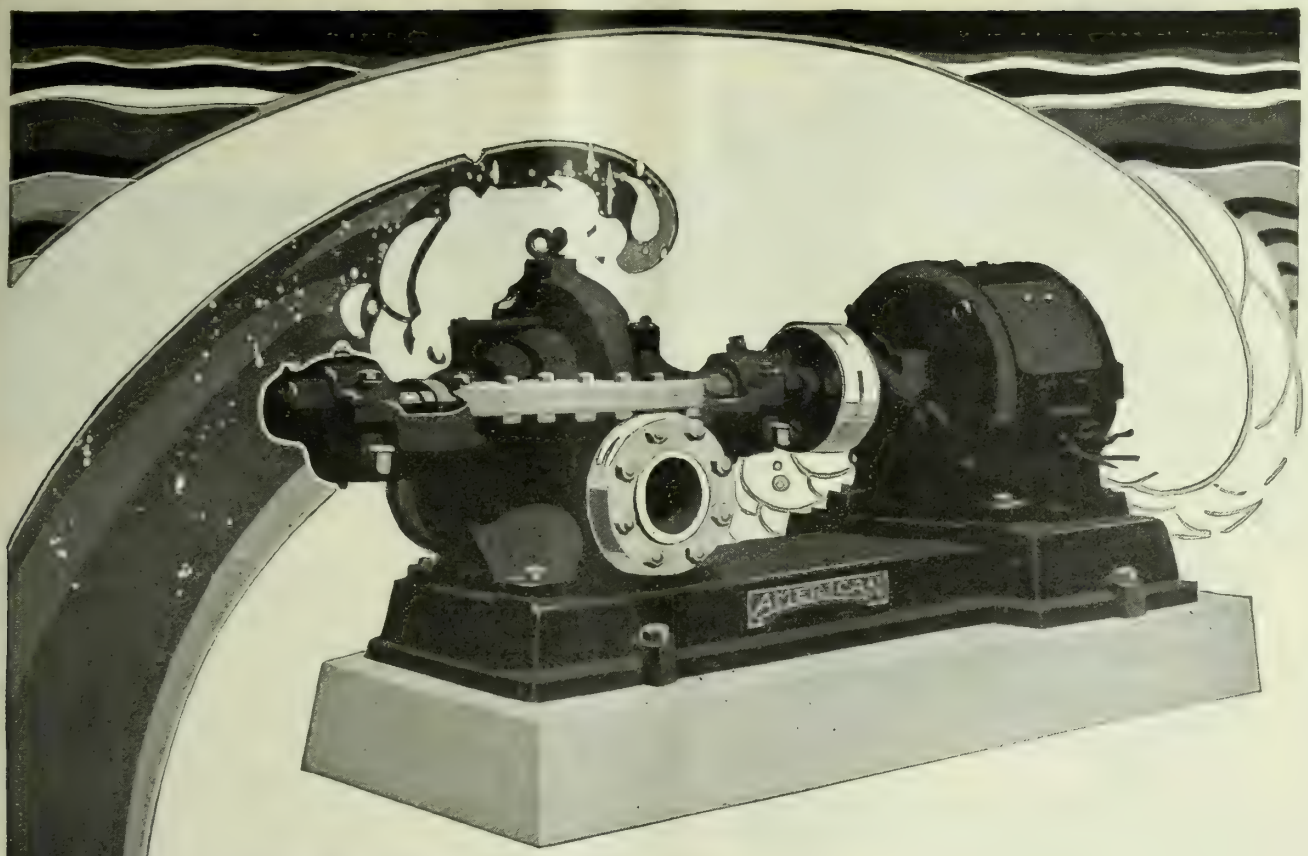


FIGURE 2.—An ingenious machine was designed "from odds and ends in our own yard" to rotate the pipe during the lining process.



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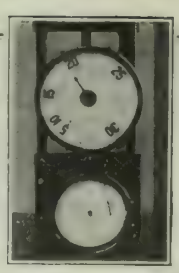

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The Reading instruments can be either Indicating, Recording or both (as in the above illustration showing reading instruments installed at Endicott-Johnson Corporation Water Works). The Reading instruments can be located at any distance from the place where pressure or level record is taken.

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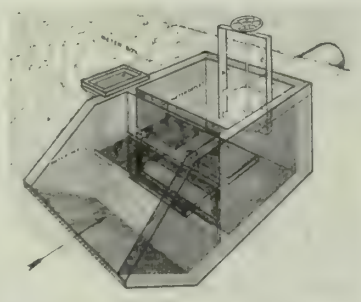

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OPERATING THE HOME-MADE ROTATOR

Mr. Lovell found that this machine worked best with a one-inch pipe running free inside the pipe which was being lined, spreading the cement evenly with a trowel-like action.

Date of Test—August, 1924

Flow in 1000 Gals. per 24 hours	Vel. in Ft. per sec.	Loss of Head per 1000 Ft.	Value of "C" H and W
299.5	2.46	3.79	142.5
498	4.09	9.23	146.2

As the cement lining should remain smooth with age, it was reasonable to assume that the value of the coefficient "C" in the Hazen and Williams flow formula would not be impaired after years of use.

Cement lining, when properly installed, presents a smooth surface, and, while the internal diameter of the pipe is slightly restricted by its use, Mr. Gibson's experiments showed a higher carrying capacity for cement-lined pipe than that of ordinary sand-cast pipe, owing to its lower friction head.

With the above information at hand, I decided to try an experiment, which, if successful, would be of interest to all water department officials—that of cleaning the 4-inch pipe mentioned in the foregoing and lining it with cement.

A pipe cleaner was made as shown in the accompanying sketch (Figure 1) with which we removed all soft rust and tubercles. No attempt was made to get the metal absolutely clean as we wished to know whether we could hold the cement in this old rusty pipe.

I had information to the effect that originally the cement was distributed in the pipe by a large iron bullet. The pipe was set on end and a bullet-shaped casting was lowered into it. The cement was then poured in and as the bullet was withdrawn it distributed the cement on the walls of the pipe.

The present method in use at the foundries is to distribute the cement by centrifugal motion. We accordingly designed a machine to work along these lines. This machine was made of odds and ends found in our own yard, as shown in the illustration (Figure 2). It was driven with a Fairbanks-Morse, 2½ H. P. type "Z" gasoline engine.

As we had been unable to get any information as to the proper speed of rotation or the mix, it was necessary for us to work this out by ourselves. Experiments were made with a number of different mixes and speeds.

Both Portland and natural cements were tried, but the best results seemed to be with the natural cement. Our final mix was seven parts natural cement to one of very fine sand, mixed with just enough water to allow to pour from a bucket, or about the consistency of cold molasses.

A trough for feeding the cement was made by cutting a length of 2½-inch W. I. pipe longitudinally with an acetylene torch.

We first tried to feed the cement with the pipe rotating, similar to the method used to pour the iron in the De La Vaud process. As this was not successful, we then filled the trough and ran it through the pipe, before starting it to rotate, dumping the whole batch at once. This worked fairly well, but gave some trouble in distributing the cement evenly.

Our present method, which has worked out very well, is to dump the mix from the trough full length of the pipe before starting rotation, then run a length of 1-inch W. I. pipe through and start the machine. The 1-inch pipe running free inside the larger pipe acts as a trowel in distributing the cement. The machine is allowed to run one or two minutes or until on inspection the ce-

ment is found to be evenly distributed, when the 1-inch pipe is removed and large pipe is allowed to spin for about ten minutes.

The proper length of time to allow the pipe to rotate must be found by experiment, as the time varies with the amount of water in the mix. The jarring of the pipe on the rolls is very beneficial up to a certain point, as it seems to throw the cement to the walls of the pipe and extract the surplus water, but, if allowed to run too long, the jarring of the pipe will cause the cement to fall away after the initial set takes place.

After experimenting with various speeds to as high as 400 R. P. M. we found the speed of 260 R. P. M. to give the best results.

SECTIONS of this pipe, which have been removed for inspection after one year's service, show the cement lining to be intact and without signs of incrustation.

Since the above experiment we have successfully lined several thousand feet of 6-inch C. I. pipe. While satisfied that cement lining is the proper procedure for this locality, it has been necessary to discontinue the work at present, owing to the lack of space and necessary funds to do the work economically.

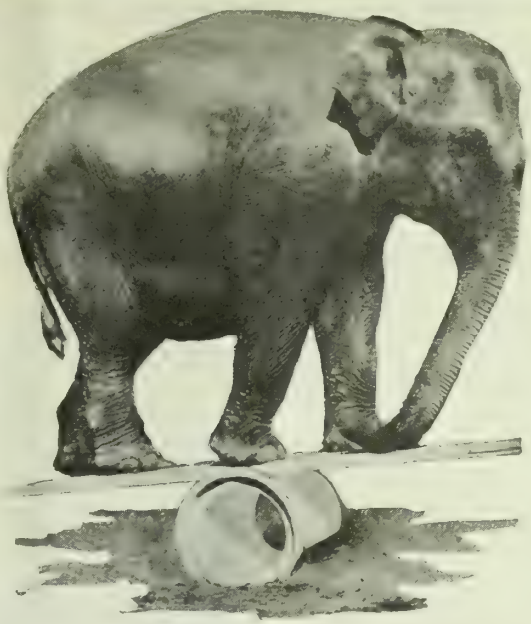
The lining averages from one thirty-second of an inch to one-sixteenth of an inch in thickness. Working as we were in restricted space and with crude apparatus, we lined 6-inch pipe for 2.3 cents per foot. This included all labor, material and power.

For cutting cement lined pipe we advise the use of some type of rotary pipe cutter, as the jar of cutting by the ordinary method with cold-cut or diamond point may damage the cement a short distance back from the cut.

It is interesting to note, however, that, according to an article by H. Y. Carson, research engineer for the American Cast Iron Pipe Company, in the case of the old cement lined W. I. pipe removed in New England, it was found that even though small spots on the pipe were not covered with the cement, these spots showed practically no signs of rusting. The theory advanced is that a film of neutralized water formed on these exposed spots and prevented the damaging elements in the water from reaching the metal.

New Reservoir for Pendleton

The city water commission of Pendleton, Oregon, has decided to build, at a location to be selected on the "north hill" of the city, a $35,000 reservoir to increase the reserve water supply and afford better pressure.



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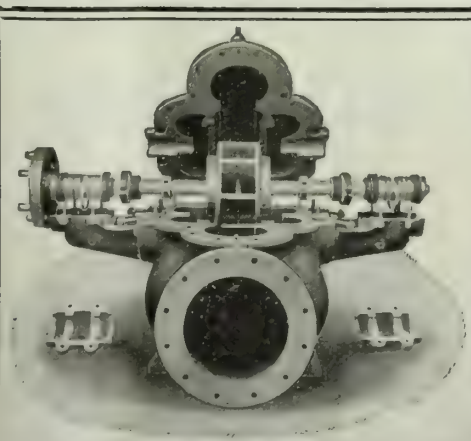

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WHO'S *WHO* AND WHO'S *WHERE*

IN THE WORLD OF HYDRAULICS

Personal Notes and Impersonal Observations About Men You Know

Stephen L. Owens has been appointed county agent in Yuma County, Arizona, to succeed R. B. Coglon, who has resigned to take up extension work in Missouri.

William Durbrow, secretary manager of the Glenn-Colusa Irrigation District, and president of the Irrigation Districts Association of California, recently addressed a meeting of land-owners at Arbuckle, California, discussing the proposed annexation of the Arbuckle section to the Glenn-Colusa district.

J. B. Lippincott, Los Angeles engineer, has been named by the city council of San Diego to examine and pass on the plans and specifications of the El Capitan pipe line shortly to be constructed by the city. The proposed line will probably be completed in less than a year.

Jose Nunez Pasquete, chief engineer of highways for the Spanish Government, was a visitor in February on the Salt River Valley irrigation project in Arizona. He is representing the government of Spain in studies of American irrigation systems which he is making preliminary to assuming charge of large reclamation activities in his own country, involving about 600,000 acres.

Elwood Mead, Commissioner of Reclamation, has been named by Hubert Work, Secretary of the Interior, to represent the department on an interstate board formed for the purpose of determining an equitable allocation of the waters of the Columbia River between the states of Oregon, Washington, Idaho and Montana.

The appointment of A. J. Lintner, of Victorville, California, as a member of the directorate of the Mojave River Irrigation District, has been confirmed by action of the Board of Supervisors of San Bernardino County. Mr. Lintner is said to represent a faction in the district which favors the sale of $2,500,000 worth of bonds voted by the district to finance a 25,000-acre irrigation project, and it is asserted that the confirmation of his appointment will result in the sale of these bonds.

Hervey Lindley, president of the Columbia Basin Irrigation League, James M. Kyle, former president of the Oregon Irrigation Congress, Charles Hebbard and Frank T. McCollough, of Spokane, and Charles Bratenover, of Minneapolis, are in Washington, D. C., in the interest of the plan of the Columbia Basin project. Their intention, it is announced, is to ask Congress for a small appropriation for preliminary work on the project.

Reorganization of the city Board of Water Commissioners of Denver, Colorado, during January resulted in the election of Ernest Stenger as president, S. M. Perry as first vice-president, and Frederick W. McCartney as second vice-president. Their election followed the resignation of Frank L. Woodward as president and B. A. Sweet as second vice-president. W. C. Danks, formerly first vice-president, resigned from the board some time ago.

W. B. Tucker, agricultural agent in Cook County, Oregon, and W. T. McDonald, Cook County agent, in co-operation with state irrigation leaders including W. L. Powers, professor of soils at Oregon Agricultural College, are planning an irrigation school to be established in Central Oregon for the benefit of farmers this summer. It is contemplated that the managers of the large irrigation projects in Oregon will assist the school, and that some centrally located city will be selected for its location.

Javier Sanchez Mejorada, well known Mexican irrigation engineer, has been named as one of three men comprising a board of irrigation commissioners, created by the federal government of Mexico. Sr. Mejorada has been the representative of the Mexican government in many of its dealings with American irrigation interests, and has lately been chief of the Mexicali irrigation zone. He is expected to exert an important influence on future irrigation developments in Mexico.

Geo. H. Trask, assistant general manager of the Randall Control & Hydrometric Corporation, manufacturers of the Reliance Irrigation Meter, has recently returned from an extended business trip through Arizona, New Mexico and Texas. He reports considerable activity in irrigation development, along with a growing demand for modern machinery and appliances for more efficiently controlling and delivering water to the consumer. Texas is rapidly forging to the front in irrigation development, aided and fostered by constructive laws and able engineering, says Mr. Trask. One thing that especially took his attention was the fine reception that MODERN IRRIGATION is receiving from the irrigation industry as a medium for the exchange of ideas, he declared, on his return.

Stuart B. Show has been appointed to the position of district forester of the California district, United States Forest Service, on recommendation of Forester W. B. Greeley, approved by Secretary Jardine.

Mr. Show is a graduate of Stanford University and received his technical education in forestry at the Yale Forest School. He will succeed Paul G. Redington, who has been chief of the California district for the past six years and will soon leave for his new assignment as Assistant Forester in Washington.

The new district forester is ably fitted by education and wide experience to handle the many and complex forestry problems of the state. Born in Nebraska, he came to California in his early youth, his father being the late Professor A. B. Show, for many years with the history department at Stanford University. Mr. Show has been an officer of the United States forest service in California for more than sixteen years. He started as a student forester on the Shasta national forest and has steadily advanced to the position of assistant district forester in forest research, which work has taken him into practically every forest region of California.

Water Power Output Larger

Production of electrical energy from water power in the United States increased 11.3 per cent in 1925, according to a report issued by the U. S. Geological Survey. Production of power from water on the Pacific Coast increased, during the same period, 43.9 per cent, while electrical energy produced from fuel (on the Pacific Coast, mostly oil and gas) decreased more than 50 per cent.

Big Orland Project Approved

A permit issued by the California Division of Water Rights contemplates the irrigation of 21,000 additional acres by the U. S. Reclamation Service on the Orland project, the most successful of the federal projects. An expenditure of $1,200,000 is contemplated in the diversion of 50,200 acre-feet of water annually from Stony Creek.

Deed Involves Large Sum

The second largest deed ever filed in the County of Riverside, California, was the one recording the sale of the property and holdings of the Palo Verde Mutual Water Company to the Palo Verde Irrigation District, for the sum of $1,274,500. The deed was filed early in January, and completes the amalgamation of the Palo Verde levee district, Palo Verde irrigation district and Palo Verde drainage district into a single organization.

Swendsen Tells Water Needs

George E. Swendsen, chief engineer of the Fresno Irrigation District, was the main speaker at a recent meeting of the Fresno (Calif.) Rotary Club, speaking on the water situation of the San Joaquin Valley in particular and the state in general. "The Valley made an overdraft of approximately 500,000 acre-feet on its ground-water supplies in 1924," Mr. Swendsen told the club, "and in 1925 gained back about a third of what had been lost."

Growth for Pump Concern

Additional proof of the importance of irrigation to the industrial as well as the agricultural prosperity of the southwest is afforded in a recent announcement of the Pacific Pump Works. This company has doubled its office space by a considerable addition to its building at 350 Bicket Street, Los Angeles, and has begun work on a large new structure for accommodating its stocks of pipe and machinery.

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RECLAMATION

HOW CAN WE SOLVE THE LAND SETTLEMENT PROBLEM?

By GEORGE H. KREUTZER*
Director of Reclamation Economics

SETTLEMENT of unoccupied or new lands in the West has been at a standstill since the war. In addition to the many settlers required to fill up the Federal irrigation projects, large numbers are needed on the irrigation enterprises developed by the use of private capital.

Some of the reasons for this inactivity during the past five years were that farming has not been a popular occupation because of the relatively low prices of agricultural products; that land prices were inflated; that taxes and other fixed operation charges were high; that the cost of developing and equipping irrigated farms had greatly increased; that credit for new undertakings was hard to get and when secured was subject to repayment terms that the farmer's income could not meet; that the capital of prospective settlers shrunk with their unprofitable investments in other occupations, all of which made it safer for them to get a job with good wages than to take land; and, finally, the lack of a cordinated and comprehensive plan of land settlement to meet the changed conditions.

During the period of high prices for agricultural products irrigated land changed hands at inflated values and mortgages increased because of these purchases. Settlers could not pay these debts when their earning power decreased, and many mortgage foreclosures resulted. The number of farms owned by banks and mortgage companies increased proportionately. No new settlers were found to take the places of those who had left.

ONE of the large Federal irrigation projects has only 31 per cent of its land occupied by resident owners. The remaining lands are either abandoned or owned by nonresidents or former mortgagees. These farms are tilled in a haphazard way by the neighbors for a share of the crops. Some of the results of this are low yields, dilapidated improvements, and hundreds of acres of weeds. Taxes and irrigation charges are not paid.

One area of this project, comprising 101 farms with an aggregate area of approximately 9,000 acres, is occupied by 15 resident owners, and the remaining 86 farms are either abandoned or owned by nonresidents. Most of those that are not already foreclosed are heavily mortgaged. The average delinquent state, county, and irrigation taxes amount to $15.83 an acre. The delinquent taxes will soon amount to more than the land is worth. Tax certificates are offered at public sale by the county authorities, but there are no buyers. County institutions are being operated largely by warrants, and the irrigation system is being operated at public expense.

The area of this project is 75,000 acres, and the United States has expended for the construction of the irrigation system approximately $3,500,000, or an average of about $45 an acre. Water was first made available in 1908, and to June 30, 1925, $481,144 has been repaid, or less than 15 per cent of its cost in 17 years. The United States has spent $1,109,625 for the operation and maintenance of the irrigation system on the theory that on December 31 of each year the sums expended would be repaid by the land owners, yet less than one-half of this sum has been paid.

IF THESE lands were poor, this situation could be more easily understood. The lands are fertile, and the climate is suitable for the successful production of alfalfa, sugar beets, potatoes, small grains, corn, and common vegetables. The water supply is unfailing, the water right cheap, and the operation and maintenance of the irrigation systems one of the cheapest of either Federal or privately operated irrigation projects. Good railroad transportation is provided, and the large eastern markets are much nearer this project than most of the remaining irrigated lands of the West. With these favoring conditions, land should sell readily and the project should be a complete financial and economic success.

One of the difficulties is that the project is located on the border line between the arid region and the section of ample rainfall; hence crops can in some seasons be profitably grown without irrigation. In other years crop yields are so low as to be entirely unprofitable, yet when good cultural methods are practiced with irrigation the yields are uniformly good year after year. One farmer follows dry-farming methods and another irrigation farming, and this does not make the highest use of the water nor does it build a profitable agriculture for the project.

The irrigation district has recognized the need of settlers and has spent considerable sums of money advertising but has not sold one farm as a result of it. Advertising alone has been a failure. Something more is needed.

THIS community chiefly lacks a group demonstration of skilled irrigation farmers, each owning and tilling his land, in which proper crop rotations are followed, good livestock kept on farms and the creation and functioning of cooperative institutions for marketing and credit made possible by a number following similar methods and working together. With this would come substantial improvements and neatness in cultivation that is properly regarded by land seekers as the reflection of community prosperity and a desirable place to live. The same character of land in the vicinity showed yields of as much as 20 tons of sugar beets an acre, 45 bushels of corn, and other crops in proportion. Such yields from one farm do not impress a land seeker nor does it build a profitable agriculture for the district.

There should be 50 or 100 farmers close together, all producing such crops,

*This paper was delivered by the author before the recent settlement conference at Washington, D. C., called by Dr. Elwood Mead, Commissioner of Reclamation.

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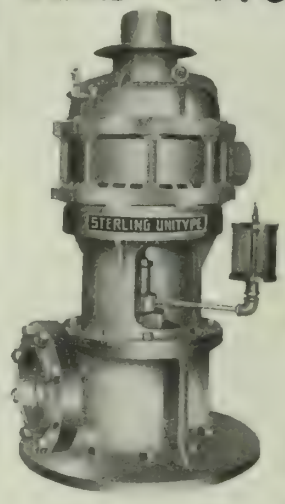

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keeping good livestock, and confining their activities to their own farms with consequent rewards. Instead of this, frequently settlers farm from one to six additional farms with their own efforts, tilling them poorly, from which they receive low returns or even losses. One settler was farming his own 80-acre farm and had six additional farms rented for sums of from $75 to $200 a farm and could not possibly put them all in crops or take care of the crops when planted.

The best way to speed up settlement and bring about more profitable agriculture in the more or less abandoned area is for the Government to acquire these lands for the delinquent taxes to save its initial investment in the irrigation system. If such a step is taken, some of the nonresidents will pay their State, county, and irrigation taxes and thus turn in to the United States Treasury considerable sums of money. Lands that are not redeemed will be acquired at not more than $20 an acre. These abandoned lands, while cheap, are in no condition to be offered to settlers. Funds should be provided to repair and repaint the building improvements, fix up the fences, and plant from 15 to 25 acres of alfalfa on each. These crops would make it possible for settlers to make an income the first year, as well as provide neat-looking properties in place of the devastated and run-down properties now existing. The cost of doing this work per farm will be relatively small and should be added to the purchase price of the land. The terms of purchase should be 15 per cent or 20 percent as a cash payment and the balance repaid in 20 years with interest at 4 or 5 per cent. Some long-time and intermediate credit should be added to this, so that settlers of small or moderate incomes can complete the development of their farms soon after they purchase them.

If this were done, the farms would be attractive, the prices moderately low, and purchase terms fixed so that the farm can be paid out of the farmer's income. It will change the appearance of these farms and the community and will appeal to purchasers as a real opportunity.

On another project of 48,000 acres only 14,000 acres were irrigated in 1924. Water has been available since 1909, but farmers have been slow to use it. Something must be done to increase the use of water for irrigation and make the revenue of the project sufficient to pay the cost of operating it. The lands of this project are fertile. The average crop value for 1924 was $39 an acre, which is as high as some of the thickly settled prosperous projects.

Fifty farms which were not tilled by their owners, and some of which were not farmed at all, were investigated, and it was found that the average delinquent general and irrigation taxes amounted to $10.24 an acre, exclusive of penalties. The delinquent irrigation charges varied from a few dollars to as much as $1,335 for a 160-acre farm. Such conditions, if allowed to continue, will make the project insolvent, while if a plan to acquire these lands is put into effect and arrangements made to make the farm attractive for settlers the use of water will increase and the cost of it ultimately be returned to the Government.

WE MUST remember that economic conditions have so improved in industrial centers during the past score of years that the old pioneer type, willing to go on the land, live in a tar-paper shack, subject his family to privations for years to make a farm out of the wilderness has practically disappeared. The same man to-day can, and does, stay in the city where he and his family have the comforts of city life and a steady income. We must meet this changing condition by providing that raw or unimproved lands shall be developed to the point where the new settler can make an income the first year. This calls for some development before the land is sold, long terms for the purchase of land, long-time and intermediate credit to complete the development of the farms and equip them with good livestock, assistance in the organization of needed cooperative institutions, and guidance and advice to settlers who purchase farms.

It is believed that with such a plan put into operation the full cooperation of all other agencies can be secured and settlers in good numbers obtained.

Williston Project Sold

Sale of the Williston Reclamation project situated near Williston, South Dakota, for the sum of $50,000 was authorized at the Interior Department in January.

The purchaser, W. R. Davidson of Williston, made the best offer to the Bureau of Reclamation after a bidder at a previous sale had refused to execute his contract and forfeited $7,700 to the Reclamation fund.

Terms of the new sale, which were the best obtainable, provide in addition to the purchase of the property that a rental of 10 cents be paid for each ton mined at the project coal mine owned by the Government.

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Cuyamaca Deal Completed

Final details of the purchase of the Cuyamaca Water Company by the La Mesa Irrigation District (Calif.) were completed in January by the payment to the Company of $1,200,000, constituting the first payment of a total consideration of $2,000,000. The property transferred includes Cuyamaca Dam, about 1100 acres in Cuyamaca Lake, Fletcher dam site, flume line, El Monte pumping plants, El Capitan Reservoir, Grossmont Reservoir, Eucalyptus Lake, Murray Dam and lands flooded, as well as all the distribution lines outside the city limits of San Diego, and all the water filings under the law of the State of California which the Cuyamaca Water Company own excepting Mission Gorge dam site No. 3 water filings. The district has an option for five years to purchase Mission Gorge dam site No. 3 from the Cuyamaca Water Company at a price of $150,000.

The Cuyamaca Water Company still retains the distribution lines in Normal Heights, Kensington Park and East San Diego, which they control together with a contract for the purchase of water from the La Mesa district.

Fire and Water

(*Continued from Page 12*)

when nearly 100,000 acres of brush cover were burned over. As most of this material is deposited where it is not wanted, it constitutes an economic waste, first from the standpoint of the decreased soil fertility of the denuded slopes, and second because of the cost of removal of the material when it is deposited in harbors, rivers, etc.

EACH brush fire, then, is a cause of considerable loss, a loss which takes its toll from each user of water from a given burned area, a toll to be paid in the increased cost of water, whether obtained from ditch, reservoir, or artesian basin; a toll to be paid in increased taxes to control and confine floods to their channel, rebuild roads, bridges, and other improvements damaged by the floods, and to dredge out channels and harbors; a toll to be paid in the decreased returns to the individual and community through decreased yields because of water shortage; a toll to be paid in the loss of fishing and hunting and the recreational value of the mountains as a playground. With such economic losses following fires in the watersheds of California, it is inevitable that each citizen should recognize that fire can extinguish water, and should learn to look upon fire as the red enemy of agriculture as well as of industry.

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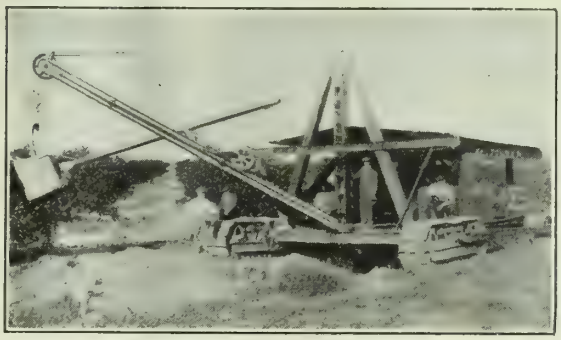
BAY CITY Land Dredges span the ditch, can dig any desired slope, and dump waste on both banks. BAY CITIES leave clean, wide berms, and can work up or down streams. One trip over the ditch is enough. The Shovel Type Dipper handles hard material in which other types of buckets cannot make a good showing.



At left—One yard BAY CITY Dredge digging and cleaning ditches in Florida Citrus Groves.

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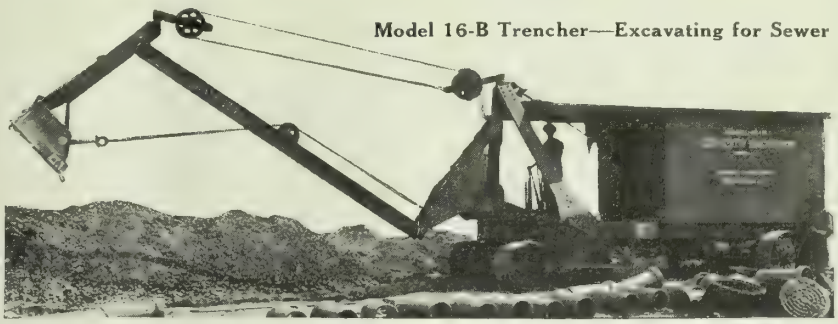

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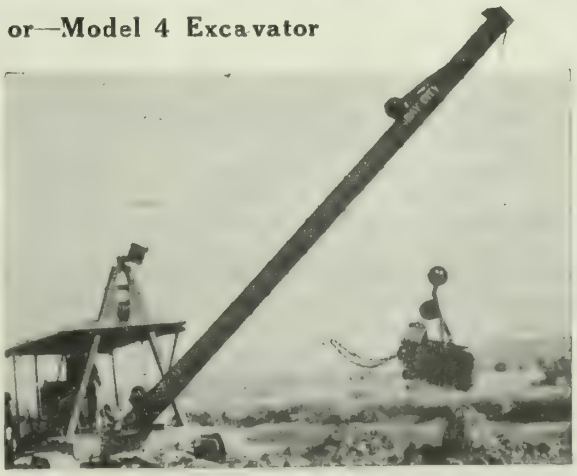

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IRRIGATION FINANCE

FINANCING IRRIGATION PROJECTS THROUGH BOND ISSUES

By W. R. WILLIAMS
Vice President, Bank of Italy

ALL THE undertakings of man require funds with which to meet the cost of whatever structure is erected and irrigation projects are necessarily governed by this same requirement. Because of this necessity, whenever a new enterprise is being launched, the first problem always is how to obtain the required funds at the lowest cost and under the most favorable conditions. This problem is not always easy of solution and many projects have gone down in failure simply because insufficient care has been exercised and improper methods used.

Some kinds of business have relatively little difficulty in raising funds for their undertakings. Particularly is this true of railroads and public utilities in general. One of the principal reasons for the greater facility with which these activities are financed is that the conduct of their business is under close governmental observation and guidance; another reason is that their methods of financing are generally known and understood; a third reason is that investors usually have a considerable degree of confidence in the ability of their business management. These elements, combined with others of importance, create confidence in the enterprises and this confidence results in a willingness on the part of the investing public to purchase these securities.

The most favored of all kinds of constructive enterprises, in reference to their financing, are what we commonly refer to as public improvements. While some public improvements are paid for direct through taxation, by far the greater volume is financed through the sale of bonds. Governmental bonds, in this country at least, find a ready market, but even in this general group there are preferences. A bond of the United States Government sells more readily and with a lower rate of interest than do bonds of the states; bonds of some states have preference over bonds of other states, and so on down through the list of governmental subdivisions. The more favorably a government is known, and the more certainly its financial stability is established, the better is the market for its bonds. This rule applies universally throughout the whole financial structure.

THE PRIMARY strength of governmental bonds is the taxing power, but even governments, whether national, state or otherwise, must be backed and supported by fundamental principles or even their bonds soon lose their reputation and character. The first pre-requisite for the creation of a ready market for any kind of security is that the security must be entitled to a first class character and reputation. For any kind of a security to be entitled to such first class character and reputation, the security must actually possess the elements of strength that it is represented to have.

This principle of the necessity of underlying strength is the one great outstanding fact that must always be kept in mind in seeking to finance irrigation district projects. Unless this essential principle be strictly adhered to, irrigation districts and their bonds are bound to suffer.

Most investors will not go to the trouble of making any personal investigation of the stability and strength of any particular proposed investment, and but very few are capable of passing in critical judgment upon the bonds of irrigation projects, even though all of the factors affecting the bonds are available to them. Purchasers rely either upon the general reputation of irrigation district bonds, or upon the reputation of the particular district, or upon that of those who deal in such commodities and who present the bonds for sale.

There is no good reason why irrigation projects should not have a reputation equal at least to that enjoyed by public utilities. Irrigation is certainly as important as any public utility, and irrigation districts may be as well founded as a public utility project, and good business management should not be beyond the reach of irrigation districts. An irrigation district is like any other project that must depend upon the successful completion of its structure to produce income sufficient for the payments demanded by the bonds issued to finance the project. *The undertaking must be completed, once it is started and its bonds sold.* The first thing to be determined, therefore, is that the conception of the project is sound. In reference to an irrigation project, the soundness of the conception is governed by many factors, chief among which are the quality of the soil, the sufficiency of the water, and ability to bring the two together within a limit of reasonable cost.

The quality of the soil should be determined at the very beginning. Unless the soil is productive, nothing would be gained by putting water upon the land. The sufficiency of the water must also be determined beyond question, for, regardless of the value of the soil, there could be no justification for saddling the cost of an irrigation system upon the land unless it is certain that sufficient water will be obtained. And, again, even though the soil is good and there be an unquestioned supply of water, no irrigation project should be undertaken without first knowing to a reasonable exactness what it is going to cost to place the water upon the land. Excessive cost would destroy the very purpose of its creation. It could not be profitably used. Nothing should be left undone to determine that these three underlying factors are to a certainty favorable.

A great amount of irrigation is, of course, developed and carried on by private enterprise. An individual may own land and develop the water therefor; likewise, a corporation may provide the necessary water for its own lands. Each such project must stand on its own merits and must be financed in the manner most available to the projector. It is well recognized however, that the most successful means for the general promotion of irrigation projects is through the medium of irrigation dis-

tricts. It is because of this fact, that it is so important that a high standard of reputation be established and maintained for irrigation districts. An individual land and irigation project may fail, and irrigation as a whole not suffer in the least as a consequence thereof; but the failure of one irrigation district serves to weaken and materially undermine the reputation of all irrigation districts.

THE SUPREME difficulty of irrigation district projects lies in the fact that they are confronted with the most serious responsibilities and problems right at the inception of the project. If an irrigation district is organized where the land is already occupied by people who are seeking to better their condition, the financial strength of such people is usually very weak; and, if the irrigation district is being put forth incidental to a land promotion, the promoter is usually more concerned with how he may sell the land than he is in the creation of a sound financial project. By sound financial project, in this reference, I mean not only the elements that go into the bonds themselves but equally those elements that go to create a successful and profitable business enterprise.

The credit of an irrigation district is at its lowest ebb at the time the project is conceived and launched. The management is not experienced; and, unless they receive effective guidance, the directors scarcely know which way to turn. The project must be well conceived and properly guided from its very inception, or else innumerable troubles arise, from the burden of which it may be well nigh impossible to obtain relief. A district goes through the process of organization but once. It must, therefore, be guided by the experience of others. It would be manifestly impossible of success if each newly organized district in turn relied solely upon its own plans and methods, conceived and put into operation by its own directors alone and unaided.

THE QUESTION then is how, and from what source, may irrigation districts receive the best and the most effective and the least expensive guidance and assistance. Because of their importance to the state, and because of the peculiar nature of and the exceptional conditions surrounding irrigation districts, the state can well afford and ought to extend to them such guidance and assistance as will insure their success. This help should not be extended from any paternal or altruistic motive, and there should be no kind of special privilege involved therein. The participation by the state in these undertakings may well be justified wholly

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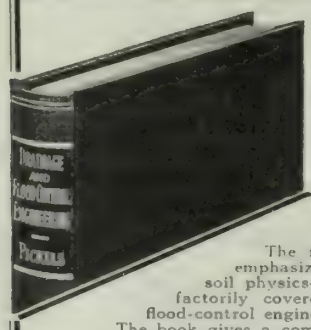

Drainage and Flood Control Engineering

By G. W. PICKELS
Assistant Professor of Drainage Engineering, University of Illinois

THIS BOOK COVERS ALL PHASES OF THE DRAINAGE ENGINEER'S WORK FROM THE DRAINAGE OF SMALL AREAS OF FARM LAND BY TILE UNDERDRAINS TO THE RECLAMATION OF LARGE AREAS BY FLOOD PROTECTION, BY DRAINAGE THROUGH OPEN DITCHES AND BY PUMPING.

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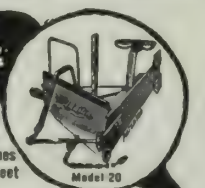

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upon the basis that it is good business.

The state should exercise its full power to see that an irrigation district project is not created and its bonds issued and sold, unless the undertaking is sound; and, likewise, the state should cause such a project to be successfully completed once it has been created and its bonds sold. The state should provide complete and efficient machinery for properly guiding and controlling the organization of irrigation districts, and for guiding their management, particularly during their formative and construction periods; and, if necessary, the state should be in a position to substitute its own management for that of the district, temporarily, at such times as the directors of the district are unable properly to conduct its affairs.

The state might very well also be in a position to lend its financial support by the purchase of bonds of irrigation districts at the time that the bonds are originally issued. The use by the state of its funds for the purchase of irrigation district bonds could be justified, however, only when the bonds of the irrigation district are unquestionably sound, and when the reputation of the irrigation district is not sufficiently well established to readily command the money of investors. The unwillingness of investors to purchase the bonds of an irrigation district may arise from a general doubt as to the stability of irrigation districts generally or of the particular district itself.

UNDER such conditions as herein suggested, the state would be fully informed as to the strength of the district and would be assuming no risk in purchasing bonds that had been issued by the district with the approval of the state. When the district had become a demonstrated success, the bonds could readily be resold. Thus the state would be reimbursed.

The probabilities are that with wholly efficient participation by the state in the creation of irrigation districts, and in the completion of the projects, there would be no necessity for the sale of irrigation district bonds to the state. All bonds of good repute are readily absorbed by the investing public.

These suggestions do not contemplate that the state shall actually guarantee the success of any irrigation district, nor that the state shall underwrite any irrigation district bonds; rather is it the thought that the state can well afford to capitalize the experience already had and the knowledge acquired, and, by centralizing the use of this experience and knowledge, and through the exercise of the power of which it is possessed, lend to irrigation as a whole a service of immeasurable value.

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MODERN Irrigation

Have You a Delegate at This Meeting?

THE COMPETITIVE business world of today moves forward on two wheels. One of these is salesmanship proper and the other—*advertising*. Whether you realize it or not, business amounting to billions is now transacted annually through the advertising pages of magazines and industrial publications. It is *here* that the preliminary skirmish of competition takes place and many a silent victory is won, or nearly won, before the salesman calls.

The advertising pages of MODERN IRRIGATION are a market-place. Here, once each month, is held a sales convention on paper. Here representatives of the leading equipment manufacturers speak their messages to the great market that buys your products.

These "silent salesmen" are an indispensable part of the general campaign; as necessary in their way as is the personal representative who stands between you and your customers, and your prospective customers. Do not, like the fabled ostrich, hide your head in the sand and imagine otherwise. You may, by cultivating such an illusion, go on saving the cost of a monthly advertisement; but if that is your policy you are slowly and certainly losing prestige, business and good will—of a far greater value to you—and making it easy for the more astute competitor, who does not believe in such limitation of armaments, to penetrate your market, overcome advantages which you hold in fancied security, and eventually outflank you on this important sector.

At this moment, the pages of MODERN IRRIGATION are being examined, and examined carefully, by men whose yearly purchases in your line aggregate large sums of money. Long-pull advertising will help you to secure a larger percentage of this annual turn-over. The men who buy are reading and studying these advertisements—never doubt it. Consciously, or unconsciously, they are forming their opinions and narrowing down their ultimate choice of equipment. Many *actual decisions* are made months in advance of the order for the goods. None but the most backward companies in business today are not fully alive to this, while those of seasoned advertising experience are now, as never before, bringing up their advertising artillery for the big year's business ahead.

There will be no disarmament in the business world the coming year—no unpreparedness in the organization of progressive business concerns. Competition will be keener than ever before. The personal skirmishes and "bouts" of your salesmen and distributors in the field will have their counterpart in the drive for business and prestige through the advertising pages. Laggards and sluggards will drop out, and fall by the wayside. Live, up-and-going companies will go forward on "both wheels."

Think the matter over. The monthly meeting on these pages will go right on, month after month, and the silent but efficient emissaries of the leading companies in your line will be present. Your own advertisement gives you representation according to your merits. Why not decide upon a campaign now, and let us talk the subject over with you?

We'll be glad to introduce your "Silent Delegate" at the next monthly meeting.

For Detailed Listings, Branch Offices, Etc., See the Buyers' Guide to Leading Supply Sources—Pages 55-56

OVERHEAD IRRIGATION

SOME IMPORTANT PHASES OF OVERHEAD IRRIGATION

By R. O. LEHR

IT IS an established fact that the top twelve inches of the soil colmun is the laboratory in which plant foods are manufactured by the various chemical and physical agencies at work in soils. This zone is the one which is richest in the bacteria responsible for many of the beneficial mild acids which take an important part in this production of plant food. It is the zone which is usually the best aerated and benefited by oxygen necessary in the soil chemical processes, and it is also the zone which is most benefited by the warmth of the sun's rays, which assist both chemical and physical processes of this plant food production. There is another factor of great importance to this zone of activity and that is the moisture element. For the reason that it assists these other agencies at work in the soil, the sprinkler, or overhead system of irrigation, is worthy of analysis.

Better Seepage

The soluble plant foods which have been manufactured in the topsoil by the agencies just mentioned must be washed down into the root zone of the tree before they can be converted into crop. We have learned that shallow furrows in the surface soil send moisture down in a "V" rather than in an "A" and as a consequence much of the soil is left dry, bacterial action is hindered and chemical conditions are not ideal. In addition, these small streams of water run in shallow furrows have had a tendency to carry soluble plant foods to the lower ends of the rows and deposit them there by seepage. This is especially noticeable where slopes are pronounced. The sprinkler system of irrigation is free of these objections. It wets the entire surface, when installed according to recent approved plans. It may be regulated so that there is no runoff to low places, and soluble plant food over the entire area covered by the sprinkler is allowed to seep down into the root zone.

This system will be readily recognized as advantageous on hillside plantings, or where land has not been carefully leveled.

Hillside Irrigation

As a matter of fact, our prime objectin leveling has been to gain easy flow of irrigation water. To gain this we have often scraped off a foot or two feet of fertile topsoil and deposited it in low places already possessed of their foot or two feet of fertile topsoil, with the result of unusual growth of crop in the rich zones and backward growth on the high spots, or scraped areas. Without doubt, in some cases an excellent sprinkler system could have been installed for little more or even less than the cost of difficult leveling, and once installed the frequent cost of furrow plowing is saved, not to mention the cost of covering the furrows after ecah irrigation and the elimination of the man with the shovel to watch furrows and regulate gates.

The question of pressure is one that calls for special solution in each case. It will be determined by the contour of the land itself; and the source of supply will also have to be considered. Some growers will find it necessary to pump directly into their pipe system, others may be fortunately situated with a high reservoir site which may be filled by gravity flow or pumping. It will be appreciated that growers who are supplied under irrigation districts from open ditches will be obliged to install additional pumping equipment to obtain pressure and in taking water from open ditches it must be remembered that screening should be effective in order that the sprinklers themselves may not become clogged with weed seeds or other foul matter. One factor in favor of sprinkling is that it cannot continually replant the land with foul vegetation as is the case with water from open ditches in many sections.

The matter of placing pipe is an important one. The item of trenching and filling trench after pipe is laid has been an expensive one, until recently. An implement has now been perfected which will bury pipe underground to any desired depth not exceeding 26 inches. The cost of this tool is not a serious item, for it can be continuously used each season as a "panbuster" to depths less than the planting distance of the pipe and the deep breakage of the lower soils from its use will benefit soils more than enough to pay for its use. The length of the string of pipe buried at one time is naturally determined by the size of the pipe itself. It is also determined by the power of the tractor available.

Laying the Pipe

More power will be required to bury pipe 24 inches deep than 12 inches deep, for the panbuster is obliged to break through a longer column of soil. The friction, or drag, of the pipe itself through the soil as it is pulled in by the panbuster is not noticeably greater at 24 inches than at 12 inches in depth. I have seen a 10 horse tractor pull with ease 150 feet of ¾ inch galvanized pipe with couplings every 10 feet. A narrow trench is dug at the starting point to permit the pipe to go to its level in the ground without bending at the point of entry.

Where tree connections are to be made it is then only necessary to dig down where the cut-in is to be made. If sprinklers are to be installed over the tree and pipe run up the trunk to be out of the way of cultivating tools, it will be necessary to dig a short trench from tree to pipe line, which is usually in the center of the row. This applies to old orchards. Where trees are very young or not yet planted the supply pipe may be run directly down the marked rows, a post-hole auger may be used where the upright pipes are to be cut in, or cutting in may be done when the hole is dug to set the tree. The company manufacturing the sprinkler used will be able to supply proper reductions for sprinklers to adjust pressure between the supply and discharge ends of the main lines when they are given proper data as to length of rows, spacing of trees, size of mains, and so forth.

We make complete installation if desired

This new Sprinkler will practically last a lifetime. We guarantee it unconditionally for five years.

Oil or grease cup in which adjustable hardened cone thrust bearing operates.

A *New Type* Campbell

Overhead Irrigation Sprinkler

THIS IS THE SPRINKLER YOU HAVE BEEN WAITING FOR — IS PERFECTLY BALANCED, HAS LONG UPPER AND LOWER BEARINGS, LUBRICATED HARDENED CONE THRUST, FELT STRAINERS TO KEEP SAND OUT OF BEARINGS AND MANY OTHER NEW FEATURES.

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SURVEY *of* HYDRAULIC DEVELOPMENT

As Shown by Official Records of the Month -- Local, State, and Governmental

Permits Issued

Among the more important permits to appropriate water issued by the Department of Public Works, Division of Water Rights of California, during the month of January, 1926, were the following:

Permit No. 2375, Application No. 4690 (Mendocino County)—Issued to Charles Thomas Smith of Hopland, Calif., for 1 cubic foot per second from Russian River. In Section 33, T 13 N, R 11 W. M. D. M. For use for irrigation of 80 acres near point of diversion. January 4, 1926.

Permit No. 2378, application No. 4559 (Los Angeles County)—Issued to H. Sandberg of Sandberg, Calif. January 11, 1926. For 0.12 cubic foot per second from an unnamed spring. In Section 33, T 8 N, R 17 W. For use for Domestic and irrigation of 80 acres in Sec. 32. Estimated cost $2.500.

Permit No. 2388, Application No. 4685 (San Diego County) Issued to George T. Simpson of San Diego, Calif. January 14, 1926. For 1.69 cubic feet per second and 150 acre feet per annum. From Surface and under flow of Santa Maria Creek in Section 11, T 13 S, R 1 W. For use for irrigation of 135 acres in Sec. 11.

Permit No. 2392, Application No. 4738 (Colusa County) Issued to Martha Wackermann of Grimes, Calif. January 18, 1926. For 0.61 cubic foot per second from Sacramento, Calif. In Section 26, T 14 N, R 1 E. For use for irrigation of 48.98 acres in sections 26 and 27. Estimated Cost $2,000.

Permit No. 2394, Application No. 4766, (San Joaquin County) Issued to California Land Finance Company, of Los Angeles, Calif. January 19, 1926. For 21.2 cubic feet per second from Fourteen Mile Slough, in Sections 24, 30, 29, Tps. 2N, Rges, 5E, 6E. For use for irrigation of 1,702.2 acres near point of diversion. Estimated Cost $33,600.

Permit No. 2398, Application No. 4720 (San Luis Obispo County) Issued to Peterson Farms Company of Los Angeles, Calif. January 21, 1926. For 1.75 cubic feet per second and 10.1 acre feet per annum from Los Osos Creek in Section 20, T 30 S, R 11 E. For use for irrigation of 140 acres.

Permit No. 2400, Application No. 3945 (Siskiyou County) Issued to Christian Bollhorn of San Francisco, Calif. January 22, 1926. For 0.1 cubic foot per second from an unnamed tributary of South Ten Eyck Creek in Section 32, T 12 N, R 6 E. H.M. For use for domestic use and irrigation of 60 acres in Sec. 32. Estimated Cost $500.

Permit No. 2401, Application No. 4636 (San Joaquin County) Issued to Mrs. Anna Bautz, of Stockton, Calif. January 25, 1926. For 1.93 cubic feet per second from Middle River in Section 13, T 1 S, R 5 E. For use for irrigation of 154.6 acres near point of diversion. Estimated Cost $3,000.

Permit No. 2406, Application No. 4730 (Lassen County) Issued to Jay C. Womple, of Milford, Calif. January 27, 1926. For 2.12 cubic feet per second from Mill Creek and 200 acre feet per annum from Mill and Dry Creeks. In Sections 26 and 23, T 27 N, R 14 E. For use for irrigation of 170 acres and stockwatering in Sections 23 and 24. Estimated Cost $2,500.

Permit No. 2410, Application No. 4575 (Tehama County) Issued to P. B. Cross of San Francisco, Calif. January 29, 1926. For 150 cubic feet per second from Deer Creek in Section 5, T 26 N, R 3 E. For use for power purposes in Sec. 5, T 25 N, R 2 E. M.D.M. 18,629 T.H.P. to be developed. Estimated Cost $1,669,648.

Applications Filed

Among the applications for permit to appropriate water filed with the State Department of Public Works, Division of Water Rights, (California) during the month of January were the following:

Application No. 4874 (Santa Barbara County)—J. G. Rinehart, in care of Preisker, Preisker & Goble, of Santa Maria, California, for .73 cubic foot per second from Los Alamos Creek, Tributary to Pacific Ocean, to be diverted in Section 21, Township 8 N, R. 33 W. S. B. M. for agricultural purposes on 58.43 acres in Sec. 21, T 8 N, R 33 W. S. B. M. Estimated cost $2,800.

Application No. 4875 (Siskiyou County)—Henry Fiock of Yreka, Siskiyou County, Calif. for one cubic foot per second from Shasta River, Tributary to Klamath River. To be diverted in Section 20, T 45 N, R 6 W. M. D. M. For agricultural purposes on 55.1 acres in Sec. 17, T 45 N, R 6 W. M. D. M.

Application No. 4876 (San Bernardino County)—L. J. Violette, in care of J. E. Ingram, of 511-12 Metropolitan Bldg., Long Beach, Calif. For 40,000 acre feet per annum. From Antelope Creek, Arrestic Crk., Rattlesnake Canyon, Tributary to Mohave Desert. To be diverted in Section 2, T 1 N, R 5 E. S. B. M. Section 22, T 3 N, R 2 E. S. B. M. Section 19, T 3 N, R 3 E. S. B. M. For agricultural purposes on 11,000 acres in Sect. 30, 31, & 32, T 2 N, R 6 E; Secs. 1, 3 & 5, T 1 N, R 6 E; Secs. 3, 5, 6, 7, 10, 14, 15, 16, 17, 18, 19, 21, 22, 27, 28, & 29, T 1 N, R 7 E. S. B. M.

Application No. 4879 (Los Angeles County)—E. R. Ruiz, R. B. 93, of Saugus, Calif. For .75 cubic foot per second from San Francisquito Creek (Underground Water). Tributary to Santa Clara River. To be diverted in Sec. 27, T 5 N, R 16 W. S. B. M. For agricultural and domestic purposes on 60 acres in Sec. 27, T 5 N, R 16 W. S. B. M. Estimated cost $3,000.

Application No. 4882 (Los Angeles County)—Harrison R. Ward, in care of D. M. Baker, of 1018 Central Bldg., Los Angeles, Calif. For 0.25 cubic foot per second and 73 acre feet per annum. From Sawpit Canon. Tributary to San Gabriel River. To be diverted in Section 13, T 1 N, R 11 W. S. B. M. For domestic and agricultural purposes on 60 acres in Sec. 13, T 1 N, R 11 W. S. B. M. Estimated cost $6,000.

Application No. 4887 (Butte County)—C. M. Faris, in care of Geo. D. Adams, of Box 36, Gridley, Calif. For 13.27 cubic foot per second from Lat. "A", Drainage Canal—Reclamation District 833. Tributary to Sacramento River via Butte Creek. To be diverted in Section 19, T 18 N, R 2 E. M. D. M. For irrigation purposes on 531 acres of rice in Sec. 19, T 18 N, R 2 E. M. D. M. Estimated cost $2,000.

Application No. 4889 (Lake County) W. F. Detert., in care of George A. Elliot, 425 Mason St., San Francisco. For 6.25 cubic feet per second and 600 acre feet per annum from Bucksnort Creek, Tributary to Putah Creek. To be diverted in Section 9, T 10 N R 6 W. M. D. M. For agricultural purposes on 500 acres in Guenoc Rancho.

Application No. 4891 (Butte County)—Henry Kossow, in care of King & King, Attorneys of Gridley, Calif. For 2.0 cubic foot per second from Main Canal No. 833, Reclamation District, Tributary to Butte Creek. To be diverted in Section 21, T 18 N, R 2 E. M. D. M. For irrigation purposes on 80 acres of rice in Sec. 21, T 18 N, R 2 E. M. D. M. Estimated cost $1,000.

Application No. 4892 (Humboldt County)—William Campbell, of Saylor, Trinity County, Calif. For 4.50 cubic feet per second, from Madden Creek, Tributary to South Fork Trinity River. To be diverted in Section 21, T 6 N, R 5 E. H. M. For power purposes in Sec. 22, T 6 N, R 5 E. H. M. 10.7 H. P. Estimated cost $1,200.

Application No. 4893 (San Diego County)—R. E. Rule, in care of Thomas H. King, C. E., 920 8th St., San Diego, Calif. For 30,000 acre feet per annum. Maximum yearly withdrawal, 2,500 acre feet. From San Marcos Creek. Tributary to Pacific Ocean. To be diverted in Section 30, T 12 S. R 3 W. S. B. M. For agricultural purposes on 4,000 acres proposed irrigation district. Estimated cost $400,000.

Application No. 4894 (San Joaquin County)—Matie S. Vail, in care of Levinsky & Jones, of Box 28, Stockton, Calif. For 8.1 cubic feet per second. From Beaver Slough, tributary to S. Fk. Mokelumne River. To be diverted in Section 8, T 4 N, R 5 E. M. D. M. For agricultural purposes on 650.9 acres in Secs. 5, 8 & 17, in T 4 N, R 5 E. M. D. M. Estimated cost $32,500.

Application No. 4896 (Sacramento County)—E. O. Morse of Elk Grove, for 11.56 cubic feet per second from Burton Slough, Mokelumne River and Burton Cut. Tributary to Mokelumne and San Joaquin River. To be

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THE SNOW PLAIN SLIDE GATE is strong, simple in construction, and has faces of both frame and slide accurately machine finished; it is as nearly tight as is possible to make a gate without locking or tightening devices.

Made in sizes 4-inch to 36-inch inclusive.

THE SNOW SLIDE GATE LIFTER, illustrated at the right, is a highly efficient worm gear device for operating Slide Gates, especially the larger sizes, when under considerable pressure. The cost is small.

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THE SUPERIORITY OF THE SNOW CLAMP GATE lies in the clamping device which holds the slide securely open at any point, also closes the gate by clamping the frame and slide tightly together, thus making it practically water tight.

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PIPE

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Work interrupted . . time lost . . if your delays were due to faulty irrigation pipe replace it with Montague.

For 75 years Montague has been making **satisfactory** steel products. Montague pipe is designed for you to lay—and **forget!**

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We also make a full line of Oil and Water Tanks—Siphons—Stacks and Steel Flumes. Prices sent upon application.

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San Francisco California

More than just a stopping place; a central point from which you enjoy most thoroughly all San Francisco's attractions—the beautiful Plaza overlooking Union Square.

Post St. at Stockton
SAN FRANCISCO

diverted in Sections 16, 20 and 28, T 5 N, R 5 E. M. D. M. For irrigation purposes on 925 acres in Secs. 16, 20, 21, 28, and 29, T 5 N, R 5 E. M. D. M.

Application No. 4879 (Siskiyou County)—Matt Kohn, in care of L. N. Lorenzen of Mount Shasta, Calif. For .08 cubic foot per second from McBride Spring, tributary to Sacramento River Watershed. To be diverted in Section 35, T 41 N, R 4 W. M. D. M. For domestic purposes. Estimated cost $18,000.

Application No. 4898 (Butte County)—Henry D. & E. C. Gage, in care of R. A. Leonard, Attorney, 1st National Bank Bldg., Oroville. For 8 cubic feet per second from Cherokee Slough, tributary to Butte Creek. To be diverted in Section 22, T 19 N, R 2 E. M. D. M. Section 14, T 19 N, R 2 E. M. D. M. For agricultural purposes on 700 acres of rice in Secs. 11, 14, 15 and 22, T 19 N, R 2 E. M. D. M.

Application No. 4899 (Los Angeles County)—1686 W. Adams St., Los Angeles. For 1.25 cubic feet per second and 50 acre feet per annum, from Canada De Los Aliso Canyon. Tributary to San Fernando Valley Watershed. To be diverted in Section 7, T 2 N, R 16 W. S. B. M. For irrigation and domestic purposes on 100 acres. Estimated cost $15,000.

Application N. 4901 Yolo County)—Frank L. Fisher, of 2908 "F" St., Sacramento, for 22 cubic feet per second from Sacramento River, tributary to Suisun Bay. To be diverted in Section 27, T 11 N, R 3 E. M. D. M. For irrigation purposes on 840 acres of rice and 150 acres of beans in Sec. 34 and 35, T 11 N, R 3 E. and Sec. 3, T 10 N, R 3 E. M. D. M. Estimated cost $5,500.

OREGON

Among the more important applications for permit to appropriate water filed in the office of Rhea Luper, state engineer of Oregon, during January were the following:

James D. Fine of Dayville, covering the appropriation of water from Cummings Creek for irrigation of 20 acres in Grant County, at a cost of $500.

Harold R. Shull and Fred Houghton of Wasco and The Dalles, covering the appropriation of water from Grass Valley Creek for irrigation of 17 acres in Sherman County, at a cost of $600.

William S. Skinner of Jordan Valley, covering the appropriation of water stored on Jordan Creek for irrigation of 4,027 acres in Malheur County.

Mrs. Arretta E. Zana of Ashland, covering the appropriation of water from Keene Creek for irrigation and manufacturing purposes in Jackson County.

Alfons Mayers of Blitzen, covering the appropriation of water from Rock Creek for irrigation of 100 acres in Harney County.

William Numro of Condon, covering the appropriation of water from Hay Creek for irrigation of 20 acres in Gilliam County.

Ochoco Irrigation District of Prineville, covering the appropriation of water from Johnson Creek for irrigation purposes in Crook County. (Twenty-five cubic feet per second requested in application.)

T. Wilson of Dufur, covering the appropriation of water from Tamarack Creek (flood and waste water) for irrigation of 20 acres in Wasco County.

John M. Flynn of Lakeview, covering the construction of a reservoir for storage of 32 acre feet of water from branches of Sherlock Gulch, and the appropriation of the stored water for irrigation of 20 acres in Lake County, at a cost of $500.

E. Karlen of Tygh Valley, covering the appropriation of water from Tygh Creek for irrigation of 20 acres in Wasco County, at a cost of $500.

R. D. Pierce of Grants Pass, covering the appropriation of water from The Canyon for supplemental irrigation of 20 acres in Josephine County, at a cost of $200.

J. W. Stringer of Grants Pass, covering the appropriation of water from Rogue River for irrigation of 20 acres in Josephine County, at a cost of $400.

S. T. Overfelt of Imnaha, covering the appropriation of water from Horse Creek for irrigation of 37 acres in Wallowa County.

Henry J. Denn of Camas Valley, covering the appropriation of water from Holmes Creek for irrigation of 60 acres in Douglas County, at a cost of $1,500.

M. M. Burtner of Dufur, covering the appropriation of surplus and flood water from Wolf Run, Tamarack, and Eight Mile Creeks for irrigation of twenty-five acres in Wasco County.

M. A. Pierson of Aurora, covering the appropriation of water from an unnamed creek for irrigation of 19 acres and operation of a ram in Clackamas County.

Power Developments

The Federal Commission at its meeting on January 28 authorized the issuance of the following licenses:

Project No. 233—To the Mt. Shasta Power Corporation of San Francisco, California, a license terminating October 23, 1973 for a power project known as Pit No. 4 on Pit River, in Shasta County, California. The project will consist of a concrete, gravity-type diversion dam forming a small reservoir in Pit River, a tunnel about 4½ miles long, penstocks, and a power house having a proposed installation of about 100,000 Kva. The operating head will be 377 feet. The estimated power capacity of the site is 62,000 horsepower. A transmission line about six miles long will connect the plant with the transmission system of the Pacific Gas & Electric Compnay which will use the power developed in its power system.

Applications for preliminary permit under the Federal water power act filed with the Commission during January included the following:

No. 687: The Oroville-Wyandotte Irrigation District has applied for a preliminary permit for a project on the South Fork of Feather River and tributaries, in Butte and Plumas Counties, California. Alternative schemes of development are proposed, one involving the construction of five power houses with appurtenant works, and the other involving the construction of three power houses with appurtenant works. About 74,625 horsepower is proposed to be developed, for sale to one of the public utilities operating in Northern California.

No. 690: Messrs. Guy T. Stetson and Henry S. Nixon, trustees for the Ojai Irrigation District, Ojai, California, have filed application for a preliminary permit for a proposed project on Sespe Creek, in Santa Barbara National Forest, Ventura County, California, involving the construction of a 180-foot dam designed to create a reservoir of 30,800 acre-feet capacity, a conduit 8.2 miles long and a power house located approximately two miles northeast of Ojai. Any surplus developed power will be sold to public-utility companies operating in the vicinity of Ojai.

Power Commission Reports Great Development in Past Year

Twenty Per Cent Increase Shown in California's Hydro-Electric Capacity

DEVELOPMENT of California's water power resources progressed at an unprecedented rate during 1925. According to compilations recently completed by the California office of the Federal Power Commission new hydro-electric plants with an aggregate generating capacity of 326,000 horsepower were completed and placed in operation during the year. This represents an increase of more than 20 per cent. The total installation of all hydro-electric plants in California is now 1,800,000 horsepower. The tabulation given below shows the present generating capacity of the various public utility and municipal systems of the state.

In a statement issued with this tabulation, the Power Commission declares:

"Congress, in 1920, passed the Federal Water Power Act which provided favorable means for the development of the publicly owned water powers. Most of the power resources in California involve the use of lands of the United States, and hence their development is proceeding under the supervision of the Federal Power Commission. In the five year period since the Act was passed the construction of water power plants has proceeded with such unusual activity that the present installation is more than twice the total capacity existing in 1920.

"The great increase in the power requirements of California is strongly reflected by the large part of the Federal Power Commission's business which involves California projects. Up to January 1, 1926, there had been filed with the Commission 196 applications covering projects in this State. This number represented nearly a third of all the applications from the whole country. The California projects authorized for construction by the Commission up to January 1, 1926 contemplate the installation of over 1,600,000 horsepower. This is almost half of the total capacity authorized by the Commission for the entire United States."

An interesting feature of this tabulation, as presented below, is the close coordination visible between hydro-electric development and irrigation. Many of the large developers of hydro-electric energy listed in this summary are organizations whose first concern is in the development of water for irrigation.

INSTALLED CAPACITY OF CALIFORNIA ELECTRIC SYSTEMS
(AS OF JANUARY 15, 1925)

System	Hydro Plants (Horsepower)	Steam Plants (Horsepower)
Pacific Gas & Elec. Co.	534,779	190,349
So. Calif. Edison Co.	470,715	287,280
Great Western Power Co.	175,334	44,220
City of Los Angeles	124,888	
San Joaquin Lt. & Pr. Corp.	114,088	72,427
City of San Francisco	111,220	
Southern Sierras Power Co.	99,530	17,580
California-Oregon Power Co.	78,200	
Western States Gas & Elec. Co.	44,388	13,401
Los Angeles Gas & Elec. Corp.		167,500
Turlock-Modesto Irrigation Dists.	25,460	
San Diego Cons. Gas & Elec. Co.		49,915
City of Pasadena		26,130
Snow Mtn. Water & Power Co.	12,000	
Utica Mining Co.	3,048	
Ontario Power Co.	2,211	
Truckee River Power Co.	2,010	
Coast Counties Gas & Elec. Co.	1,326	1,675
City of Alameda		3,015
Coast Valleys Gas & Elec. Co.		1,842
Escondido Mutual Water Co.	804	
Total	1,801,011	875,334

Total Capacity Hydro & Stream Plants.....2,676,345 Horsepower.

For Detailed Listings, Branch Offices, Etc., See the Buyers' Guide to Leading Supply Sources—Pages 55-56

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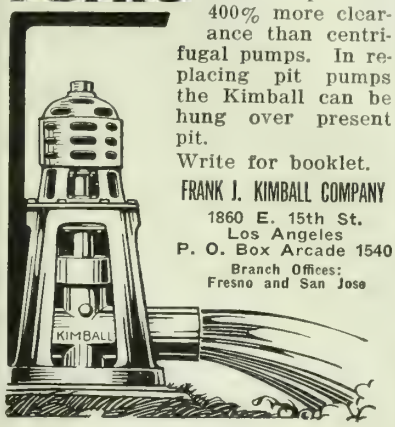

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If you feel that you can "measure up"—and your record and standing will be investigated carefully—get into communication at once with: Box XYZ, care Modern Irrigation.

AMONG OUR CONTRIBUTORS

Editorial Jottings About Current and Forthcoming Feature Articles, Dealing With Practical Problems of Hydraulics, and the Men Who Have Written Them

PROBABLY no man in the world is better qualified, by experience and official position, to discuss such a subject as "Fire and Water" from the standpoint of the effect of forest fires on water supply than E. N. MUNNS, who has written the article under that title in this issue.

For the past fifteen years Mr. Munns has been studying the relationship between fires and forests, and the correlative relationship of water supply to these factors. He was graduated in 1911 with the degree of Master of Science in Forestry. He spent one year in the Shasta National Forest, in California, on timber estimating, tree studies and fire protection; and in 1912 was assigned to the Angeles National Forest, with his headquarters in Los Angeles, California, where he had charge of nursery, planting and experimental work.

His service in this capacity was so marked that he was given charge of the Converse Forest Experiment Station and until 1918 directed all forest research work in Southern California on the Santa Barbara, Angeles, and Cleveland National Forests.

During 1918 and 1919 Mr. Munns served with the War Industries Board in charge of the lumber production division. Returning, in 1919, to California, he was assigned to San Francisco, in charge of research work throughout the state. In 1921 he was "loaned" to the state of California by the Forest Service and spent two years in the study of flood and erosion problems in California. In 1923 he resumed his work in the Forest Service, being stationed in Washington, and now has charge of all the silvical research work of the Service in the United States. He is the author of numerous articles in the technical and popular press on forestry subjects, and of several official bulletins.

A LEADER in the hydraulic development of the northwest, and one who is taking a prominent part in the preliminary negotiations leading to the development of the Columbia River's water resources, is R. K. TIFFANY, who has written the article on this issue entitled "How Water is Controlled and Administered in a State that Has Plenty of It." Mr. Tiffany is state Supervisor of Hydraulics in the state of Washington. Certainly there is no one better able to discuss this subject than he.

PROFESSOR FRANK ADAMS' article is the second installment of a very valuable paper which he contributed at the recent meeting of the Western Division of the United States Chamber of Commerce, at which he had charge of that part of the program dealing with water conservation.

ADDISON T. SMITH has contributed to the pages of this magazine before, and is no stranger to the irrigation industry. When he was a young man in Idaho he became acquainted with the needs of western arid lands, and convinced of the wisdom of federal reclamation. He was then serving as secretary to Senator Shoup of Idaho. Through the succeeding years, as register of the land office at Boise, and as secretary to Senator Heyburn, he retained his interest in reclamation problems, and when he was elected as a Representative in Congress from Idaho in 1912 he had opportunity to put into practice his convictions. In ten years of service in Congress he became chairman of the committee on Irrigation and Reclamation, which position he still holds.

E. N. MUNNS

The camera caught Mr. Munns in a dour moment—possibly when he was gazing upon the ruins in the wake of a severe mountain rainfall and run-off.

FRED A. NOETZLI, who describes the very interesting experiments undertaken by the Engineering Foundation in the construction of the test dam on Stevenson Creek, is secretary of the foundation's committee on arch dam investigation. His headquarters are in Los Angeles. HUGH CRANE, writer of the article discussing the activities of the Western Irrigation Equipment Association, is a staff contributor.

DEPARTMENTAL contributors to this issue are men of prominence in their several fields. A. P. LOVELL is Superintendent of Water for the City of San Diego, California. He is one of the leaders of water works development in the west, and his department is the first city water department on the Pacific Coast to make practical investigations of cement lining for cast-iron pipe. In a personal note to the editor he expresses confidence in the merit of this type of lining for the solution of the special problems which it is designed to meet, and the conviction that, in time, as city officials become familiar with the practical side of this matter, it will have a wide acceptance.

"Interpreting Engineering as a Fine Art" is reprinted from the admirable San Joaquin *Power Magazine*, published by the San Joaquin Light and Power Company, to which acknowledgements are due for permission to reproduce both the article and the accompanying cuts. SIDNEY GREEN, writer of the story, is associate editor of the publication.

GEORGE H. KREUTZER is well known as an expert in that very important side of reclamation—its economics. He is connected with the Bureau of Reclamation as Director of Reclamation Economics. W. R. WILLIAMS, as an executive of the great Bank of Italy, represents a financial institution which has manifested a practical interest in reclamation and irrigation developments. R. O. LEHR is associated with the Killefer Manufacturing Company, Los Angeles, and through several years of study, observation and experience with overhead irrigation, has acquired a valuable fund of knowledge on many aspects of this new and interesting subject. His short article in this issue touches on only two or three points in this connection; in the next issue of the magazine he will continue the discussion.

The March issue of the magazine will discuss some very interesting developments in the fields of irrigation and water works. "How Irrigation Has Created a New Industry" will be the subject of an article in an early issue, written by DONALD MITCHELL, who is connected with the Date Growers' Association at Indio, California, and who will discuss some interesting phases of this new orchard crop whose development into one of the agricultural industries of the west has been made possible entirely through irrigation. E. K. BARNUM, superintendent of the City Water Corporation of Fresno, California, has written a valuable technical article on balancing reservoirs, which will appear in the March number.

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Published Monthly by Petroleum World Publishing Company, Inc.; Copyright, 1926; All Rights Reserved
For 12 Months: $2.00; Single Copies: 20 cents.

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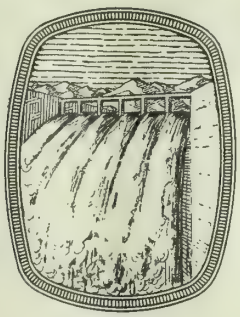
PETROLEUM WORLD 626 S. SPRING ST., LOS ANGELES, CALIF. MODERN IRRIGATION

M. C. HINDERLIDER

State Engineer of Colorado, who in this issue tells of the consummate importance of irrigation to that state. He speaks from the vantage point of twenty-five years' experience in the practical development of water supplies throughout the southwest for irrigation, municipal and power uses. In his article, he pays high tribute to the work of Colorado's irrigation pioneers, and declares that the whole basis of Colorado's present wealth and future greatness is to be found in the artificial application of water to its agriculture.

MODERN Irrigation
The Magazine of Applied Hydraulics



Volume II MARCH, 1926 Number 3

The Progress *of* Irrigation

WILL the sixty-ninth Congress, after all its hearings on the subject of the Colorado River, actually decide upon any form of constructive action in the matter before adjournment? Observers of the Washington situation may be found who declare, with seeming evidence to justify the opinion, that the outlook for definite action is really more encouraging (to the advocates of the plan embodied in the Swing-Johnson measure) at the present time that it has ever been during the whole long tedious course of agitation and negotiation.

Secretary Hoover, testifying early in March before the house committee on irrigation and reclamation, made a statement which is described, by press reports, as a strong endorsement of the bill, without the modifications suggested by Secretary Work, whose report several weeks ago identified the Colorado River development officially as an "administration" measure. Secretary Hoover told the committee that there is urgent need for immediate action, and that the recalcitrance of Arizona should not be allowed to delay the decision of Congress. Arizona's rights, he held, are amply protected in the bill.

Sunset Magazine, which has recently devoted a good deal of editorial attention to the Colorado River, from the attitude of a supporter of the Swing-Johnson plan, sees in the statements of Secretaries Work and Hoover ground for substantial encouragement. In its March issue it declares: "It is apparent that the federal government is going to proceed with the development anyway. . . . Secretary Work of the Interior Department has submitted to the senate committee on irrigation and reclamation a report recommending that the federal government build the dam when six of the Basin states approve the Colorado River pact. . . . Secretary of Commerce Hoover is in favor of building a dam in the Colorado River, and it is known that President Coolidge supports the proposal. . . . After many years of weary delay it now seems that the turbulent Colorado River will be tamed and made useful to the great, growing west that needs its water and the cheap electric energy its water can create."

Arthur Bent, newly elected president of the Los Angeles Chamber of Commerce, threw the influence of that organization strongly into the balance late in February when he addressed tele-

grams to both of the secretaries, urging that no "last-minute" modifications or amendments should be allowed to interfere with action on the measure at the earliest possible moment.

ON THE OTHER hand, however, the opponents of the Swing-Johnson bill are able to discern in the present congressional situation very significant indications that the present Congress may debate its oratorical way to adjournment without doing anything with the Colorado River. The amendment, suggested by Secretary Work, providing for a federal bond issue of $125,000,000, has given the opponents of the measure a new line of attack. They now contend that this provision for revenue raising must constitutionally be approved by the House of Representatives before it may come before the Senate for consideration. Should they be sustained, the Senate committee would give the bill no further consideration until it is passed in one form or another by the House.

The continued unwillingness of Arizona to ratify the Colorado River Compact also remains a potent force of delay.

All things considered, action during the present session of Congress is a very speculative matter, with the odds apparently against those who are anxious for immediate approval of the bill.

HEAVY RAINS in parts of the west which had feared a water shortage in 1926 have resulted in a general spirit of optimism and encouragement in irrigation and agriculture, and this has been reflected in business of all kinds. Throughout California, where the water shortage seemed most threatening before February's storms, the rains have been general, and while in most sections the seasonal total still lacks something of the normal, it is so far above the corresponding mark recorded a year ago that thanksgiving and confidence in improved water conditions for the summer season are widespread.

In many mountain points the snowfall has actually gone above the normal point for this time of year, and has assured an abundance of run-off for irrigation and power later in the season. In the Owens Valley, from which a large part of the municipal water supply of the city of Los Angeles is derived, a surplus of water is in prospect. More than eight feet of snow is standing in the Sierras above Bishop.

An appreciable stimulus has been given to business activity in California by the *volte-face* of the water outlook. A Los Angeles banker, commenting on the quickening of the commercial pulse in the last thirty days, told the story of a farmer who applied to his bank for a loan late in January, and was refused accommodation. In February, after the rains, with optimism general and a new spirit already manifesting itself in both retail trade and finance, the banker advised the applicant to renew his request for the loan, feeling that perhaps the change in conditions might make his proposition more "bankable." To the surprise of the farmer, the loan which had been refused three weeks before was this time readily granted. This is typical of the results which the rain has brought, not alone in Southern California, but throughout the state.

Capital which was beginning to tighten, under the influence of an imminent "dry year," has been released from tension, and is available for irrigation expansion, larger plantings, the purchase of equipment and similar improvements.

IRRIGATIONISTS of Idaho and of Washington met in their respective irrigation "congresses" in February, at Pocatello and Yakima. These periodical meetings are excellent things for irrigation in general and in particular the sections which they represent. Both organizations are planning worth-while constructive activities for the coming year.

Warren G. Swendsen, who has been president of the Idaho Irrigation Congress for the past year, in his message to the organization at the annual meeting, brought forcefully before the membership a question which needs periodically to be asked of every similar body. He said: "The last session of the Idaho Irrigation Congress did me the honor of electing me president, and since that time I have given no little consideration to the question of *what excuse exists for the organization*—whether or not, after all, we are justified annually in attending these gatherings and spending our time and money to engage in them?" From that point, his message was a keen analysis of the needs of Idaho from the standpoint of irrigation, and a careful discussion of what practical service may be rendered by such an organization as the Idaho Irrigation Congress. Mr. Swendsen is right; his example may profitably be emulated by the executives of all such bodies, not only in irrigation, but in every other field. Unless we constantly evaluate our organizations in terms of their service, they soon come to dominate those who have created them.

Mr. Mitchell, author of the accompanying article, caught in the midst of one of the date gardens that he writes about. The photograph illustrates the basin system of irrigation generally used in date culture.

How *Irrigation* is Creating a *New Industry* in the *Hot Spot* of the *American Desert*

By DONALD MITCHELL

IN THE Coachella Valley of California, that portion of the Salton Sea Basin lying north of the sea itself, are found conditions very different from those generally encountered in the agricultural west. Before the advent of the irrigator with his magic water, the valley was a desert, with mesquite and sagebrush as its principal vegetation. Now thousands of acres of cotton, onions, peas, string beans and other vegetables are found, as well as thrifty orchards of grapefruit and picturesque date gardens. The transformation wrought by water during the last quarter of a century is little short of marvelous. In spite of a rainfall of one to four inches annually, the Coachella Valley farmer raises bumper crops of fruit and vegetables and ships them all over the country.

High mountains form the western wall of the valley. The two most prominent peaks, San Gorgonio and San Jacinto, tower over 11,000 feet into the air and carry snow caps the year around. Melting snow and rainfall from this range feeds the underground reservoir which underlies the whole valley. Wells make this water easily available with lifts of from 30 to 150 feet. Some of the larger ranches have installed semi-diesel engines for pumping and are finding them highly satisfactory, but the bulk of the water is pumped by electricity furnished by the Southern Sierras Power Co.

PROBABLY the most interesting, and certainly the most picturesque crop of this unique region, however, is the date.

The intense heat of the summer and the customary absence of rain during the ripening season combine to make the Coachella Valley an ideal locality for growing dates. The date palm, though thriving in most parts of California, will not produce good fruit except under the most favorable conditions. This fact limits the commercial production of dates in this country to a very small area.

About 25 years ago, largely through the efforts of Dr. W. T. Swingle of the United States Department of Agriculture, the federal government was induced to conduct experiments in date growing to see if the barren deserts of Arizona and California could not be made productive. Scientific men went to the date growing regions of the old world and secured offshoots from the best varieties to be found. These were brought to this country and planted in selected places and their growth studied. The early years of the industry were filled with many problems and disappointments and the courageous souls who gave their time, money, and in some cases their lives to the difficult task of pioneering a desert country in order that a new industry might be brought into being, deserve prominent places in the agricultural Hall of Fame.

At the present time, date growing has passed the experimental stage and is recognized as a practical and profitable undertaking. More progress has been made, it is claimed, by growers in this country in the last 20 years, than has been made in the Old World in many

A maturing crop in the Coachella Valley. The dates ripen from September to December, and in the harvest season the visitor may imagine himself transplanted to the Sahara or Mesopotamia. The outer layers of fruit must be protected, lest they ripen too early, by the fiber covers that are visible in this photograph.

centuries. Our growers have been successful in solving problems that seemed at first insurmountable and are convinced that a most alluring future lies ahead.

When a date garden is planned, offshoots from a variety that is recognized as being commercially valuable are secured and planted, usually 30 feet apart each way. The Deglet Noor is by far the most extensively planted, with the Khadrawi, Saidy, Halawi, Tazizazoot, Maktum, and Thoory forming most of the balance. The planting of date seed and seedling offshoots has been largely discontinued as being unprofitable.

Offshoots are removed from the mother palm by means of a huge chisel and a sledge-hammer. This operation must be carefully done and experts in this work are in demand during the planting season. The first few weeks after setting out, the young offshoot is irrigated daily or every other day until it is well established. There seems to be no case on record where the date palms on well drained soil have been injured by too much water. As the palms grow older the irrigation interval usually used seems to be twice a week in the summer tapering off to once a month in the winter. Cultivation after each irrigation is not necessary as the sandy nature of the soil prevents the forming of hardpan.

SEVERAL systems of irrigating are in general use. Some water the entire area between rows by means of furrows, others make one furrow paralleling each row and fill basins dug around each palm. These basins are enlarged as the palm gets older. This system is sometimes changed to the check system when the trees reach full bearing.

Cost of water varies greatly due to differences of soil, lift, pumping equipment, and irrigating practices followed, but should range between $25 and $50 per acre per year. There are a few flowing wells in the lower part of the valley but with increased acreage going into cultivation each year it is thought that they will eventually be put on the pump.

A male blossom is tied loosely in the heart of the female palm in order to insure successful pollenation. This is one of the male blossoms.

Fertilization is now the subject of study and experiments. The desert soil is rich and few growers apply fertilizers during the early life of the palm, but with the production of a heavy tonnage of fruit year after year comes the problem of maintaining the proper condition of soil fertility. Cover cropping is growing in favor as humus and nitrogen are two things most desired. Melilotus Indica and the vetches have been used with success. Barnyard and sheep manure have also been tried and found profitable but a recognized best method of fertilizing date palms has not yet been developed.

During February and March a visitor to the valley will observe the date grower busily engaged in pollinating. In order to secure a good setting of fruit the grower must assist nature and apply pollen from the blossom of the male palm, which bears no fruit, to the female bloom and tie it loosely with a string. A ladder that comes to a point at the top has been found well adapted to this work, as it is easy to thrust upward through the leaves when it is necessary to reach a bloom at the center of the palm. At this time of the year, at least, it can be truthfully said that the life of a date grower has its ups and downs.

The date palm is comparatively free from pests and natural enemies. The only one that gives the grower much concern is the Parlatoria scale. This pest was brought over from the old country upon offshoots. It has been the object of an active campaign for several

(*Continued on Page 24*)

An "Outline of Irrigation"

An Account of Reclamation Development in the United States as Reflected in the Evolution of the Division of Agricultural Engineering

By W. W. McLAUGHLIN

Associate Chief, Division of Agricultural Engineering, Bureau of Public Roads, U. S. Department of Agriculture

AT THE BEGINNING of the concluding decade of the last century, irrigation was in a rather chaotic condition. There was a confusion of water laws, a complete lack of uniformity in the procedure of acquiring title to the use of water, and a questionable security of such title when obtained. There was no provision for land settlement, selection of settlers, farm financing, or marketing of farm products, and speculation was general.

It was at this time that Congress undertook the work that finally resulted in the formation of the present Division of Agricultural Engineering of the Bureau of Public Roads of the Department of Agriculture. In the early nineties Congress provided for an irrigation inquiry, and undertook in 1896, the formation of the Division of Irrigation Investigations, "for the purpose of collecting . . . valuable information and data on the subject of irrigation and publishing the same in bulletin form."

The scope of these investigations was broadened by subsequent enactment as the demand for information on irrigation became more general. There had also arisen in the humid region a demand for information on land drainage. As a result of improper use of irrigation water in the older irrigated sections of the West, areas of land which at one time had been most productive, became too wet to permit the growth of any crops other than hay, or too alkaline to support plant life, or both. This demand, coupled with the drainage problems of the humid sections, led to the creation of a drainage office associated with the irrigation investigations. The work was finally designated as irrigation and drainage investigations under the Office of Experiment Stations. In 1907 Dr. Elwood Mead, who had been in charge of the investigations since 1898, resigned his position and Dr. Samuel Fortier, who for some years had been associated with the work, was made chief of the irrigation investigations. Charles G. Elliott was placed in charge of the drainage investigations, being succeeded in the position a few years later by S. H. McCrory.

In 1914 Congress consolidated irrigation and drainage investigations, the Division of Rural Architecture and one or two other minor divisions in an "Office of Public Roads and Rural Engineering," and later, when federal aid in road building was provided, this form of organization became the Bureau of Public Roads with a Division of Agricultural Engineering, the present form under which we are now working.

THUS FROM a simple inquiry into irrigation practice there has developed a division covering the entire field of agricultural engineering. This Division deals not only with problems of developed enterprises but also with problems of organization and development.

MR. McLAUGHLIN presented a most interesting paper to the Idaho Irrigation Congress, meeting in February at Pocatello, taking as his subject the work of the Division of Agricultural Engineering, of which he is Associate Chief, as it touches reclamation and irrigation affairs. The accompanying article is taken from the first part of his paper, in which he takes up the historical background of the Division's organization and the extent of its present activities. In a future issue of the magazine he will continue the discussion, dealing with the special fields in which the efforts of the Division will probably be directed in the future.—EDITOR.

The majority of the investigational work has to do, however, with those problems common to developed and going enterprises.

The natural and economical course of development in most irrigated valleys has been the construction of small, cheap ditches to water the low lands first, to be followed later by larger, higher, and more expensive works. As a result, in many valleys there is a paralleling and duplication of ditches, and opposition of rights, which lead to excessive costs of maintenance and operation, extravagant loss of water, wasteful use, and conflicts over water, where there should be a unifying and rebuilding of ditch systems and a community of rights. A revision of irrigation systems offers fully as good an opportunity for agricultural expansion in the arid region as the construction of new works.

As water becomes more valuable, there is a need to improve conduits of all kinds so as to prevent losses of water, as well as forestall injury to the land.

All these lines of work with old lands involve questions of agricultural practice and organization as well as construction, and deal principally with private irrigation works which supply practically all such lands.

During the past thirty years the Division of Irrigation and later Agricultural Engineering has done much to improve irrigation and drainage practice, stimulate economic use of water, decrease water waste and in general guide the farmers in coping with reclamation problems of both east and west.

LET US review briefly the irrigation development of the west from the settlement of Utah in 1847 to the beginning of the speculative period in the eighties. For a little more than a third of a century, following the first settlement in Utah, development and settlement spread gradually. During this time the Middle West was settling and there was no great demand for irrigated lands. Development was normal, canals being built as they were needed and not far in advance of settlement.

About 1880 attention was attracted to the success of irrigation in the arid region, and led on by the great increase in land values, due to irrigation, capital rushed into this field and a great many large canals were built far in advance of any effective demand for land. The ditch builders could not secure title to the land covered, because it was public land and could be secured only by settlers and in small tracts, but the investors hoped to secure the increase in land values indirectly by selling to the settlers so-called "water rights." The settler could acquire land from the Government through the homestead act or by means of the desert-land entry, but a home could not be maintained on these arid lands without irrigation water. For this reason the promoter thought the settler could not do without him. He overlooked the fact that he could not do without the settler; that the settler had only to stay away and the canal builler had only a ditch, the cost of maintaining which would soon exceed its cost of construction. And the settlers did stay away, or came so slowly that most of the large canals were financial failures.

The building of so many canals had other effects. It proved the inadequacy

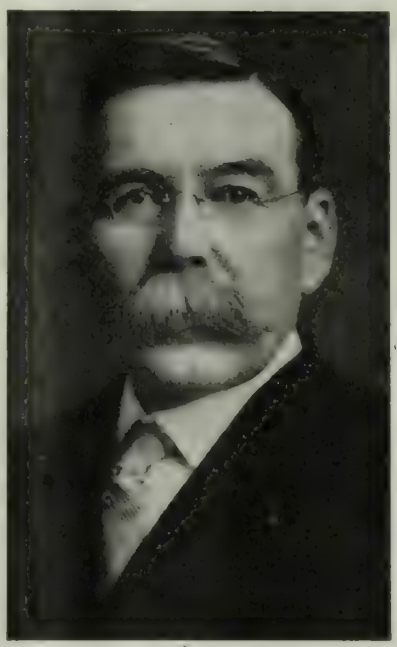
of the water laws of the Western States. Most of these States early recognized the right of appropriating or diverting water from streams for beneficial use and that among appropriators the first in time was the first in right, but they did not provide a means of determining the extent or date of appropriations, or any agency for protecting the earlier appropriator against later comers. Along many streams the capacity of the canals built exceeded the flow of the streams.

In the eighties and early nineties irrigation and canal companies made no attempt to base water charges upon land productivity and the quantity of water allotted was found upon the judgment or whim of the engineer, project manager, chief financial representative, or any one else that might at the time care to express an opinion. One of the first tasks undertaken by the Division of Irrigation was the study of laws and customs of the several states governing the appropriation and use of water for irrigation. There were two fundamental principles in force differing materially in their provisions. One was based upon the right of priority of appropriation and use, and the other upon the English common law doctrine of riparian rights. Some of the states had by constitutional provisions adopted one law while other states had adopted the other, and still other states had adopted no special water legislation but relied upon the common law. As a result of our studies of laws and customs the Division urged the adoption by the several states of certain fundamental principles to govern the acquiring of water rights and maintaining titles thereto. These principles are now reflected in the laws and customs in nearly every one of our western states.

There were practically no laws governing drainage reclamation and the present state laws are for the most part based upon recommendations of this division. The district reclamation acts, which are largely the outgrowth of the California Wright Act, likewise reflect the suggestions of this Division.

The early measure of the quantity of water attached to a claim was most frequently determined by the size of the ditch with little or no reference to the area of land under the ditch, and for this reason the right was indefinite. There was gradually written into the water acts or recognized in court decisions, or both, as the measure of water rights such terms as "beneficial use," "reasonable use," and at present "economic use." These changes in the laws and customs governing the measure of a water right are due almost entirely to work done by this Division and its cooperating agencies in determining the value of water in crop production and the requirements of both crops and soils for water. Our studies on the duty of water or water requirements did not stop with the kind of crop grown and nature of soil, but included seepage losses in conveying water to the farm and losses due to faulty irrigation practices.

AS UNAPPROPRIATED water became scarcer and more expensive to obtain, or where water was at too low an elevation, there was created a demand for information on pumping appliances and equipment. Congress provided, early in the work, for a study of power used in irrigation. This Division made a survey of existing plants, efficiency tests of engines, pumps and other equipment, as well as a comparison of the cost of pumping water with different machinery and using various sources of energy. The results of these tests and investigations were published from time to time and resulted in a more or less standardization of certain equipment and methods of installation.



SAMUEL FORTIER

Prominently identified with the development of the Division of Agricultural Engineering, and head of its irrigation activities from 1908 until his recent retirement from the position.

The old crude method of determining quantity of water and defining it as the amount that can be carried through a flume of so many square inches cross-section, or a ditch so wide and deep has gradually given way to the adoption and use of a more exact method of water measurement. Many contrivances were advocated by many people and agencies and from these a very few have become standard. The use of certain water measuring devices has long been advocated by this Division, as has also the idea of measuring water used on individual farms and fields. This Division is at present perfecting a device to be installed in canals and ditches for the accurate determination of the quantity of water carried by the canal or ditch.

A great many irrigation schemes have failed through the inability of the settlers to meet the imposed terms and unforeseen conditions that might have been foreseen. Many reclamation projects which were unsound economically have been planned and promoted, and it is such schemes and projects that have caused a considerable part of the difficulties of irrigation development. In many cases no attention was paid to the productivity of the soil or differences in productivity within the same project, no thought given to the ability of the soil to produce sufficiently to meet the terms of payment or to warrant the expenditure of that amount of money in its development. Areas of land were included in such projects that never could pay for their development and through their failure imposed additional burdens on the better lands. The larger area was frequently included under a ditch to cut down the apparent per acre cost of development.

Still other projects failed or partly failed for various other reasons and these failures could frequently have been foreseen had the conditions been properly analyzed. Numerous projects have succeeded and in the past few years we have done much to determine the different factors pointing toward success as well as those pointing toward failure. It has been our aim to determine some of the fundamental economic conditions that must be taken into account if we are to judge correctly the agricultural and economic feasibility of a reclamation project. During the last two or three years this Division has been called upon to make agricultural and economical reports of proposed projects by the Bureau of Reclamation and by the Certification Commission of some of the western states.

These economic and feasibility studies have emphasized the fact that there was, until recently, an unoccupied field between the work of the engineer and the work of the agriculturist. Experience has shown that this unoccupied field was vital in many cases to the success of the project. This is the field this division occupies in reclamation development, the one of combining engineering and agriculture in their economic relation to practical farming. Our studies have shown the importance of weighing the income against the cost; of trying to increase the one and decrease the other.

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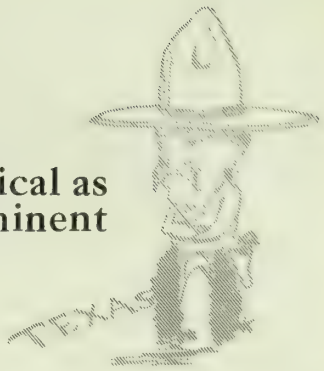
The Riddle of the *Rio Grande*

Question of Division of River Water is Critical as Large Mexican Developments Appear Imminent



By C. H. PEASE
Secretary, Lower Rio Grande Valley Water Users Association

TWO PARTS—PART ONE

THE WAR WITH MEXICO began down in the Delta region of the Rio Grande. It was the title to this far-away section that was the immediate cause of the war. Texas asserted that its southern boundary was the Rio Grande, while Mexico contended it was the Nueces River, which enters the Gulf in the vicinity of Corpus Christi, some 150 miles farther north. When the United States annexed Texas, it annexed this boundary dispute also. General Taylor marched down the coast from Corpus Christi to take possession of the lower Rio Grande country and met the Mexicans at Palo Alto, where he fought the first battle of the war.

For more than a half century this land lay almost forgotten. Then a railroad penetrated the Delta and development began. Today this most southerly area is also one of the most promising irrigated districts in the United States. It has nearly a million cares of fertile, alluvial lands suitable for irrigation. At the present time there are over 400,000 acres under fifteen projects, of which over 250,000 acres are now actually being cultivated and irrigated. A population of approximately 100,000 is supported by the industries of the Delta and all of these are dependent entirely upon irrigation.

Millions of dollars have been invested in irrigation equipment and tens of millions in farms and farm equipment in the valley and the values of all of these are dependent upon a water supply from the Rio Grande. There are 500,000 acres of the most productive land in the world still to be brought under cultivation if, and when, a sufficient water supply can be obtained.

BUT THE RIO GRANDE is not the exclusive property of the United States. Being the boundary between the United States and Mexico, it is the joint property of the two nations and subject to their joint jurisdiction. Mexico has a very large area of land in the Delta, probably fully as large and fully as desirable as any land on the north side of the river. Thus far, however, she has made very little use of Rio Grande water. Outside of a few small individual enterprises, there is practically no irrigation on the Mexican side.

Some very important questions are now arising out of this international situation. How much of this water can the United States safely appropriate with the assurance of retaining permanent title to it? How much of this water will Mexico claim, and how much is she entitled to?

There are other facts demanding consideration. The total annual flow of the Rio Grande at Brownsville, under present conditions, with everything being shut off above the Elephant Butte dam in New Mexico, averages around 5,000,000 acre feet. But most of this water is discharged at seasons of the year when there is little use for it. There is a period of low water in the Spring, at the time of peak demand, when the flow sometimes dwindles to 1,000 or 2,000 second feet. This is about sufficient to meet the ordinary requirements of the present cultivated area. There are from 100,000 to 200,000 acres under the various systems in the delta yet to be brought under actual cultivation, and there is considerable doubt of there being sufficient ordinary flow to meet the needs of this additional area.

No arrangements have been made with Mexico for building storage or diversion dams on the Rio Grande. Consequently, all irrigation at present is dependent on the normal flow, lifted out of the river by pumping, the lift varying from 15 to 60 feet. There is no way to increase the water supply by storage except through arrangement with Mexico which will make provision for some kind of international system of river control.

About two thirds of the Rio Grande water-shed (below Elephant Butte dam) lies in Mexico. Development in the delta region is, therefore, waiting for some understanding with Mexico which will permit the development of an additional water supply through storage.

There are no existing treaties with Mexico which contemplate irrigation from the Rio Grande below Fort Quitman, a point about 70 miles below El Paso. The treaty of Guadalupe Hidalgo, which disposed of questions arising out of the war with Mexico, explicitly declares the Rio Grande to be a navigable stream, and prohibits any interference with its use as such. Under a strict interpretation, therefore, it would seem that any diversion of the water for irrigation is in actual violation of this treaty.

THERE IS A TREATY with Mexico, however, which undertakes to determine Mexican and American rights in the Rio Grande down to Fort Quitman, and which gives Mexico the right to 60,000 acre feet delivered to her free of charge from stored water in the Elephant Butte. The treaty contains a stipulation explicitly denying that the United States admits any right on the part of Mexico to water originating in the United States.

This treaty was negotiated for the purpose of settling Mexican claims to water which had been used by Mexican citizens at Juarez for a hundred years before its source, the Rio Grande, or a portion of it, passed under the jurisdiction of the United States. Denying any legal right, the United States tacitly admitted an equitable right, by consenting to supply the Mexican needs from water stored at the Elephant Butte Dam.

About a year ago the citizens of the Rio Grande Delta brought to the attention of Congress the facts of this perplexing situation. Congress authorized the creation of a joint commission to cooperate with a similar commission to be appointed by Mexico, to study the equitable use of the waters of the Rio Grande. The American commission was appointed, consisting of Dr. Elwood Mead, Commissioner of Reclamation, as chairman, Gen. Lansing H. Beach, retired Chief of Engineers, U. S. Army, and W. E. Anderson, of San Benito, Texas.

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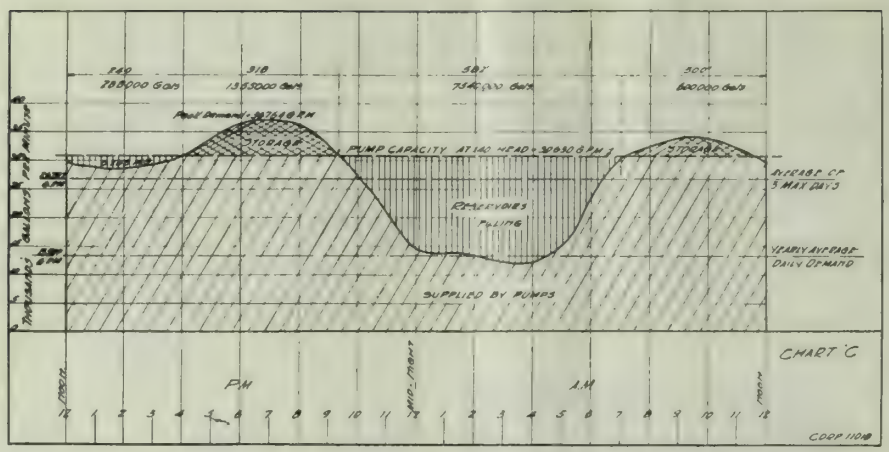

CHART C—A graphic picture of the average hourly load curve for three maximum days of 1924, showing the required storage for the period of peak demand.

Supplementing *Pump Capacity* With *Balancing Reservoirs*

A Discussion of the Problem of Meeting Peak Demands With an Auxiliary Supply

By E. K. BARNUM*

Engineer, Fresno (California) City Water Corporation

IN CITIES where the topography is more or less level, and natural elevated storage sites cannot be obtained, the question of meeting the maximum hourly demand with pumps or gravity water becomes a problem of designing the works to meet the peak conditions or to supplement the above with stored water, from elevated tanks or surface reservoirs with booster pumps. In the former case a large investment in major equipment results, with corresponding fixed charges often passing the economic limit, while, in the latter case, we are confronted with the problem of balancing annual operating expense, plus fixed charges on our pumping equipment, against that of meeting the peak demand or a percentage thereof, with stored water from balancing reservoirs.

As the economics of the problem require a careful study of load factor conditions, on each particular system before storage capacity should be decided upon, this phase of the problem will be touched upon but briefly.

A hypothetical water works plant will be considered, and a method outlined, as a suggested method of determining the relationship between maximum hourly demand and pump capacity versus storage requirements.

A city of 80,000 inhabitants will be considered operating on a flat rate basis, the average daily demand being 19.5 M.G.D., total consumption of water measured at the pumps. We will assume that the supply is being pumped from the underground waters, and that the plants are distributed throughout the city and pumping direct into the mains. Any additional pumping plants must be so located that interference between wells or overlapping of cone of depression will not be obtained, and that there is a limit to the number of pumps which can safely be installed in the area considered.

CHART A (†) is submitted herewith and shows the hourly load curve for the maximum month of the year studied, and represents the demand expressed

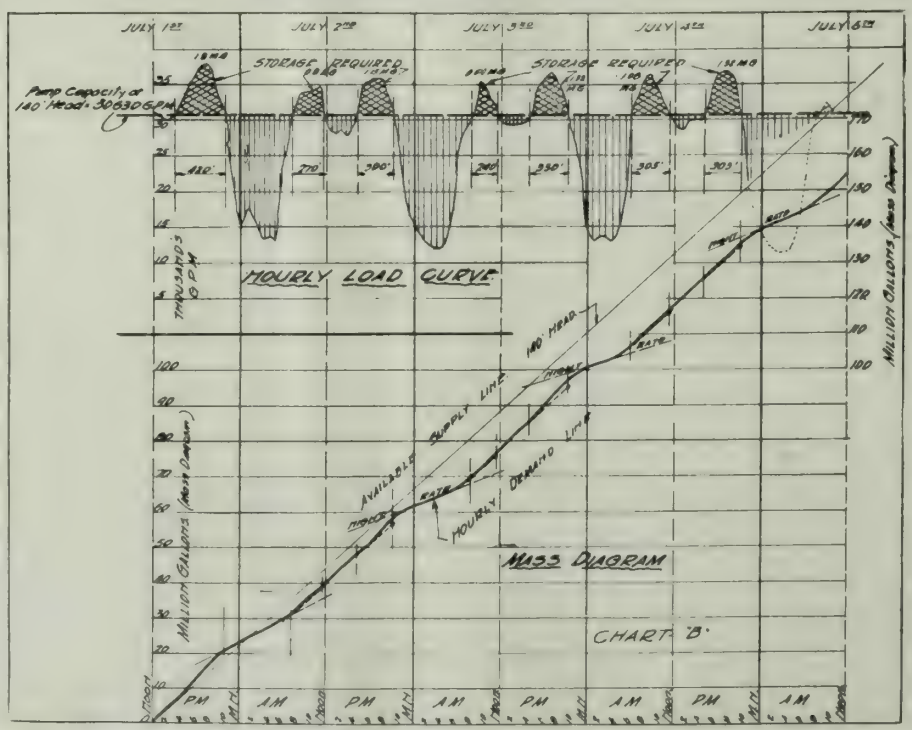

CHART B—Mass diagram and hourly load curve for maximum days of 1924. It is derived from the Chart A, which was too large to be reproduced in this article, and shows in detail the most interesting features visible in that chart, which plotted the hourly load curve for the entire course of the maximum month of the year studied.

*This article was presented by the author as a paper before a recent meeting of the California Section of the American Water Works Association, under the title "Balancing Reservoirs to Supplement Pump Capacity During Peak Demands." Acknowledgements are due to the Society and the author for permission to publish the article.

†EDITOR'S NOTE: Chart A, which the author describes, is not reproduced in this article, being too large for reproduction on a page. Its nature, and the conclusion to be derived therefrom, are apparent from the author's discussion. The most interesting study of this chart is made of the three maximum days, which are reproduced on Chart B, shown herewith, together with accumulative pumpage for the period. Chart B appears at the left.

in gallons per minute. The total consumption for the month is 1016 M.G. or 22,750 g.p.m.; this represents an average monthly load factor of 60.4 per cent. From a study of the performance curve of each pump, the capacity in this case was taken at a total head of 140 feet and then summarized, the result being the available supply at such a head, (namely 140 feet,) that normal service could be rendered. This is seen to be 30,630 gallons per minute. At all points wherein the demand curve is seen to be above the available supply line, then auxiliary capacity is required either in the form of additional pumps, or storage released. It is to be noted that there are only three or four days of the entire month that normal service could be rendered with the present pump capacity.

In order further to study the conditions, the three maximum days have been selected from Chart "A," and reproduced on Chart "B," together with a mass curve showing accumulative pumpage for this period. The mass curve is of the usual form, the demand line being accumulative pumpage, while the supply line represents available supply at 140 feet total head. Any line parallel to the supply line, and drawn tangent to the demand line, has a maximum ordinate whose value represents deficiency in supply. This is further shown on the hourly load curve, as all areas above the available supply line can be integrated and storage requirements determined. Summarizing the above, then it is seen that:

(1) That the average daily demand for the year=19.5 m.g.d.

(2) Pump capacity at 140 feet head=30,630 g.p.m.

(3) Maximum hourly demand (three day average) =36,764 g.p.m.

(4) That for approximately 10 hours for each of the three days selected, the demand was equal to or greater than the available supply, resulting in service being rendered at a reduced pressure head.

(5) Pump capacity in per cent of average daily demand =227 per cent.

(6) Peak demand (three day average) in per cent of average daily demand=273 per cent.

(7) Peak demand in per cent of pump capacity=120 per cent.

By reference to the mass diagram it is seen that the average night rate of flow is about 12,500 g.p.m., while the average rate during maximum demand period is about 33,000 g.p.m. or approximately 264 per cent of the night flow.

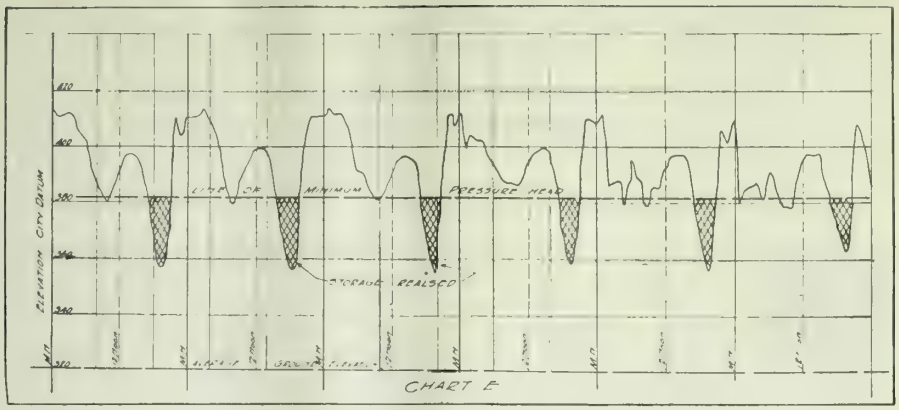

CHART E—Hourly elevation hydraulic grade line, Arlington Heights, maximum days of 1924. Fresno City Water Corporation.

CHART "C" is now plotted as an average curve for the three maximum days and reflects the average system operating conditions from which final conclusions may be drawn, as to deficiency in supply during peak demand period, and pump capacity. From 4 P.M. until 9:30 P.M. it is obvious that the pump capacity should be either increased or auxiliary supply furnished in the amount of 1.35 m.g. If reservoirs are provided then, 13.5 m.g. mentioned above, and about 600,000 gallons during the morning load, or from 7 A.M. to 11.30 A.M. or in other words, about 20 per cent more capacity is required to equalize the flow during peak conditions.

Chart "D" represents graphically the operating condition of the system during this three day maximum period. It is seen at once that to supply the peak demand of 36,764 g.p.m. storage or auxiliary supply is necessary; with a pump capacity of 30,630 g.p.m., representing approximately 227 per cent of the yearly average daily demand, there remains a deficiency in the amount of about 17 per cent of the peak demand to be provided. Chart "D" is further useful in the determination of the economic solution of this problem as the cost of storage expressed in terms of per cent of peak capacity is readily balanced against cost of equivalent pump capacity in terms of per cent of yearly average daily demand.

It is assumed, herein, that if storage is to be provided that it will be utilized throughout the year, and the pumping plant so operated that maximum use of stored water will be obtained. By this scheme of operation certain plants may be shut down as the average daily demand decreases, allowing the remaining plants to operate at a higher load factor, and efficiency, which is very desirable in a system of this kind.

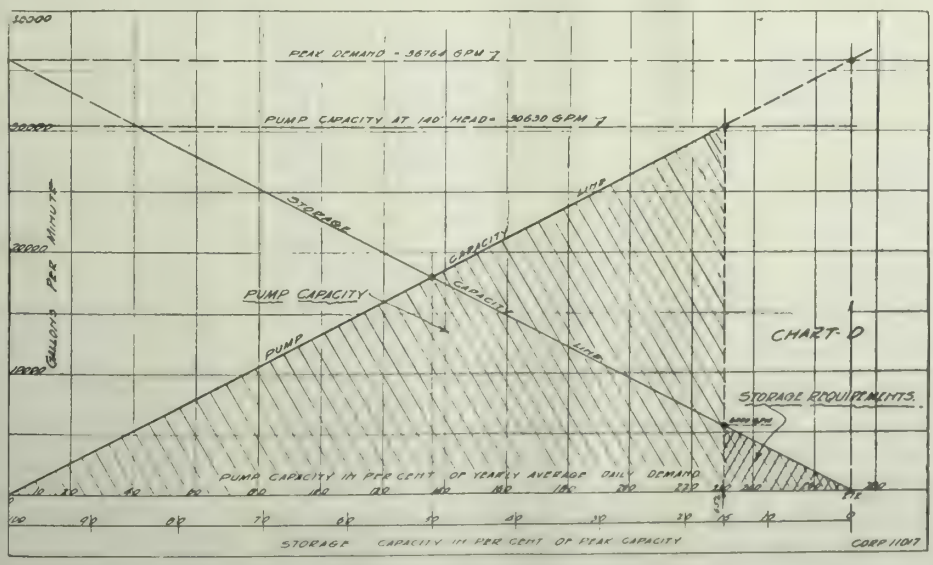
PEAK DEMAND = 36764 GPM
PUMP CAPACITY AT 140' HEAD = 30630 GPM
STORAGE
PUMP CAPACITY
CHART D
STORAGE REQUIREMENTS
PUMP CAPACITY IN PER CENT OF YEARLY AVERAGE DAILY DEMAND
STORAGE CAPACITY IN PER CENT OF PEAK CAPACITY
CORP 11047

CHART D—These curves show the relation of pump capacity to required storage capacity for the maximum days of 1924.

The economics of storage versus additional pump capacity should now be studied, and the annual cost of operation plus fixed charges of both schemes balanced. There will be found a point or a balanced condition wherein the total annual cost of operation of pumping plants expressed as a percentage of average daily demand will

(*Cont. on Page 36*)

Why Are Our Irrigation Organizations?

Leader of Hydraulic Developments in Northwest Discusses Proper Function of Idaho Congress

By WARREN G. SWENDSEN

State Reclamation Commissioner of Idaho, and President, Idaho Irrigation Congress

THE LAST session of the Idaho Irrigation Congress did me the honor of electing me president and since that time I have given no little consideration to the question of what excuse exists for the organization —whether or not after all we are justified annually in attending these gatherings and spending our time and money to engage in them.

It occurs to me that this is what might be properly termed an age of conventions, clubs and organizations and, perhaps, we are spending too much time in such activities. I am inclined, therefore, to suggest that an inventory be taken at this session with a view of determining whether this Congress should be continued, and, if so, what its future activities should be.

According to the best available estimates fifty per cent of Idaho's water supply available for irrigation is already devoted to that use and about six per cent of the total available water power is developed. This condition suggests that we have only fairly started the task of putting our water resource to a beneficial use. There can be no question but what the completion of this development presents a problem of vast importance to the entire state.

WHEN Mr. Swendsen prepared and delivered the following remarks, which are taken from his address to the annual meeting of the Idaho Irrigation Congress, he had in mind specifically the organization which he was to address as president. But there is much of general application and value to irrigationists and irrigation organizations in every part of the country in what he has to say, and for this reason his remarks are reprinted at some length.—EDITOR.

It is, however, an open question as to what institution of government or what organization is best equipped to assume the responsibility of directing plans designed to bring about the highest possible beneficial use of our unappropriated water supply. Quite independent of what organization, whether government or otherwise, undertakes this responsibility, it seems to me very evident that its solution must ultimately rest in the crystallization of public sentiment.

THE FOLLOWING problems appear to me to be of vast importance: We have a much greater area of desert land in Idaho than the total available water supply will accommodate even if it were all used in irrigation. Physical conditions suggest numerous schemes under which the surplus might be utilized. If the state's interest is to be adequately considered, and it is assumed that this is the sincere desire of all its citizens, and particularly this Congress, we must apply the remaining water supply to the areas and uses which will contribute the greatest possible benefit.

In the past this problem has not received consideration in its broadest aspect. Fortunately, however, the resource has not been dissipated or the development thus far has not been detrimental. Our success has, however, been more of a matter of luck than the result of scientific study. Economic errors have been made and it is not expected that they could be avoided in the development of a new country. We cannot forecast future conditions with such accuracy as to permit building an empire without the necessity from time to time of remodeling plans and wrecking structures, in order to meet continually changing conditions; indeed, such remodeling and changing is often, in the end, good economy. I believe if we profit by our past experiences, future development can progress in a more orderly fashion eliminating to a large extent economic waste.

For example, had we fully realized years ago the value and necesity of impounding water in the American Falls reservoir, we probably would have reserved a reservoir site for such use and thus avoided the later necessity of moving a town of considerable size, moving a portion of a transcontinental railroad, appearing before Congress to adjust the boundaries of an Indian reservation and purchasing accrued power rights.

Has the time arrived when we should begin to give consideration to matters of this kind in the building of our future

(*Continued on Page 24*)

HEATED discussion on various phases of state and national reclamation policies featured the annual meeting of the Washington Irrigation Institute at Yakima on February 10 and 11. Retiring president Ralph B. Williamson, in his annual address, vigorously attacked the "defeatist" attitude of the U. S. Bureau of Reclamation, asserting that "the $8,000,000 due and unpaid into the reclamation fund from the state of Washington, of which so much capital has been made, dwindles when it is disclosed that $44,000,000 has been paid, and the $8,000,000 is all that remains of a $52,000,000 debt."

The attitude of the state administration was given by Erle J. Barnes, director of conservation and development, who opposed the adoption of a state reclamation policy, declaring that state reclamation "does not work out." State Senator D. V. Morthland, as a representative of the majority opinion in the recent legislature, presented the other side of the picture of state reclamation, and urged that the Congress postpone any action adverse to state reclamation until after the report of the legislature's joint committee which is making an investigation of the problem.

F. A. Kern, of Ellensburg, secretary of the Kittitas reclamation district, was unanimously elected president of the Congress for the ensuing year. Under his direction the organization will undertake practical work on a scale not hitherto attempted. He was directed by resolution to appoint a standing committee of five to collaborate with the state supervisor of hydraulics in the formulation of a definite state program for obtaining an accurate survey of water resources of the state.

IRRIGATIONISTS of Idaho met in the joint session of the Idaho Irrigation Congress and the Idaho Chapter of the American Association of Engineers at Pocatello on February 25, 26 and 27. Leaders of reclamation, irrigation and engineering from all parts of the state were in attendance.

One of the principal matters discussed at the meeting was the extension of the scope of the organization to include more than irrigation developments, and the undertaking of a comprehensive program covering all phases of water development in the state. This was the recommendation made by W. G. Swendsen, state reclamation commissioner and president of the Congress. The organization is looking to a material broadening of its activities as a result of the meeting.

President Swendsen's address was the main feature of the opening day of the Congress, and his analysis of the water development needs of the state occasioned widespread interest. W. W. McLaughlin, head of the irrigation and reclamation work of the Division of Agricultural Engineering of the Department of Agriculture, addressed the meeting on the functions of his division as related to Reclamation. (His address is reprinted, in part, in this issue.)

"Federal Reclamation" was the subject of an address by Dr. John A. Widtsoe, well-known reclamation expert, on the second day of the convention. He was followed by William J. Hall, State Commissioner of Public Works, who spoke on "Public Works in Idaho."

The eternal snows of Colorado are her great water reserves. James Peak in winter garb, viewed from Moffat Road.

What Irrigation Has Done For My State—*COLORADO*

By M. C. HINDERLIDER

MR. HINDERLIDER is state engineer of Colorado. His is the second of a series of articles to be presented in MODERN IRRIGATION, *in which eminent westerners will tell what irrigation has meant to their respective states.*

COLORADO is pre-eminently an agricultural state, although classed, and properly so, as one of the eight arid states of America.

To those who have lived wholly in a humid region, the foregoing statement may seem paradoxical. To the Westerner, however, there is no enigma, since he is not accustomed to think of rainfall and humidity as essential to crop production. To him, successful agriculture means the artificial application of water to the soil through irrigation. Aridity plus irrigation means bountiful crops and agricultural achievements.

Irrigation is that art of ancient and modern civilizations, the practice of which enabled the early progenitors of man to exist, provided the foundation and support for the greatest civilizations of the past, succored the nations of more recent times, and now safeguards the existence of millions in their constant struggle with the grim spectre, famine. No other influence in history has had a more beneficent effect upon the well-being of mankind than has the practice of irrigation, and in no other country have the results of such practices been more pronounced, than in the State of Colorado.

Colorado is a commonwealth blessed beyond measure with scenic attractions of inspiring grandeur, with mineral wealth of endless variety, a salubrious climate unexcelled, great valleys of fertile lands, cradled among majestic mountains mantled with eternal snows; and with vast stretches of rolling plain requiring but the life-giving stimulus of irrigation. It is mighty empire of developed resources, splendid in present accomplishments, yet poor in comparison with future possibilities.

THE HISTORY of irrigation in Colorado is one of heroic achievement in empire building, and its annals are replete with the romance of a great work well done. Who, except one of prophetic vision, could have sensed the true significance of the struggles of those hardy pioneers of the early sixties, who through individual effort constructed the miniature canals for the growing of vegetable and forage crops needful for the bustling gold camps of those days? Or the great achievements resulting from the foresight and perseverance of those bold spirits, who, through a community interest, conceived and built the first extensive systems for reclaiming the supposedly sterile uplands adjacent to the streams, and pointed the way for those greater developments later made possible through corporate endeavor? Or the tremendous expansion over far-flung areas, through municipal, state and federal activities? Who but a seer could have visioned the great labyrinth of the twenty-eight thousand miles of canals now serving the four million acres of irrigated lands, or the thousand reservoirs with their millions of acre-feet of water, sufficient to submerge to a depth of many feet the entire city of Los Angeles and the San Fernando Valley. Surely these achievements constitute epics of transcending interest in the history of human endeavor.

What may *not* be said in praise of this genie which has changed dreary wastes into places of plenty, transformed uninhabitable areas into communities of activity, converted ravaged valleys and desert plains into well tilled farmsteads and happy homes, and unlocked nature's treasure houses with their great blessings of sufficiency?

UPON the results of irrigation in Colorado, a million people depend, and by virtue of its beneficent blessings, her future millions will rejoice in abundance. From her factories, wholly dependent upon irrigation, are annually produced two million tons of sugar beets, almost the equivalent of the combined output of all other sugar producing states of the West. An adjunct to this industry, that of livestock feeding, produces annually many thousands of head of finished cattle and hogs, and has made Colorado the greatest sheep feeding center in the United States. But for her irrigation practices, great livestock, mercantile, manufacturing, mining, and banking interests could not exist, and transportation systems would languish and cease to

(*Continued on Page 25*)

The EDITORIAL

MODERN Irrigation

An Organized Voice for the Forces of Agriculture and Industry Which are Primarily Dependent upon Irrigation.

Published Once a Month
AT LOS ANGELES, CALIFORNIA, BY THE
PETROLEUM WORLD PUBLISHING CO. *Editorial and Executive Offices, 626 South Spring Street, Telephone Broadway 3262.* Branches: SAN FRANCISCO—447 SUTTER STREET, *Telephone Garfield 2772;* H. E. TAYLOR, *Manager.* CHICAGO—1163 MONADNOCK BLDG., *Telephone Wabash 8855;* JOSEPH E. O'CONNOR, *Manager.* NEW YORK—503 FIFTH AVENUE, ROOM 308, *Telephone Vanderbilt 8753;* WERNER HAUPTLI, *Manager.*

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By Annual Subscription in the United States and possessions, $2.00; Foreign, $2.50; Single copies on sale in the irrigation country, 20 cents. In ordering change of address, give both the old and the new address. Allow ten days for re-entries on the subscription list. Advertising rates and circulation data upon request. Checks should be made payable to Petroleum World Publishing Co.

Vol. II MARCH, 1926 No. 3

"Intangible Realities"

ONE OF the most unusual and illuminating analyses of the key problem of reclamation—colonization—that has appeared in this magazine, or in any other publication, is Dr. Widtsoe's article in this issue, in which he gives the five essentials to a successful settlement policy.

It will be instantly noticed by the reader that three of the five essentials which Dr. Widstoe enumerates as the requisites for successful reclamation are not material factors. Five lessons have been learned, he declares, from great American experiments in land settlement. The first of these is "that no enterprise in colonization can succeed unless the project is adequate to enable the farmer to meet his obligations and to live properly in this day of high civilization." The second is that settlers must be selected in accordance with their fitness to live and labor under prevailing project conditions. The third lesson is that settlers must be aided, financially, technically and by friendly interest and encouragement. The fourth is that there must be an organized community life. The fifth—one which the author admits is difficult to define—requires a spiritual purpose, organized either around a church or some other expression of those intangible things which are nevertheless the most real stuff of human experience.

Every one of these five factors stresses the intangible—the things of the mind and spirit. The first and third are more than half matters of the heart and brain, rather than of the bank-account and material substance. The second, fourth and fifth are almost exclusively such.

There were men of prophecy, in days long gone by, who had the vision and the courage to pierce through the extrinsic manifestations of matter and to see, and declare, the underlying realities. They were more numerous then than now. Today, while there is no lack of unselfish purpose, and sincere dedication to the task, there is too much reliance on those things exclusively that may be seen and measured. Dr. Widtsoe is rendering a great service to all the irrigation brotherhood in bringing forcibly to its attention that while dams and ditches and dollars make farms possible, they do not make farms. While they may grow crops, they do not necessarily create satisfactions for human needs. Underlying the outward appearance there are those "intangible realities" that constitute the determining factors in human relations.

Should We Expand?

THERE are two ways of viewing the agricultural situation in the United States. One of these is admirably illustrated in the recently issued fourth annual "agricultural outlook report" of the United States Department of Agriculture. This report warns the American producer of farm products against any general expansion. Admitting that the farming industry is in the best general position that it has occupied since 1920, it declares that any general increase in production this year would tend to place agriculture in a less favorable position than it now holds.

The recommendations of the Department of Agriculture are based, it must be admitted, on very strong considerations. The so-called "business cycle" is not limited to commerce and industry. It applies with very great force to the economic and phychological motives that actuate the producer of farmstuffs. Today the farmer finds himself in a favorable position in the cycle, with his goods bringing fair returns in real income, and the danger is that these welcome circumstances will stimulate a chain of expansion and overproduction which will bring him again to a condition of glutted markets and unprofitable production. He needs to be warned, just as the manufacturer and the merchant need to be warned, that caution must be observed if he would maintain his pleasant position.

But there is another way of viewing the agricultural situation. It is a method that reckons not so much in terms of a given crop and a given market for a given year, but rather in the terms of the advancing population of the world and of each of its several parts, in relation to the food supply, also in-

POINT *Of* VIEW

creasing, but not keeping pace with the growing population.

The irrigationist, as a practical producer of goods which must be sold, is compelled to consider the immediate agricultural outlook from the standpoint typified in the report of the Department of Agriculture. But, as a believer in the movement of irrigation, he finds encouragement and justification and inspiration when he looks into the future, and views the gradual encroachment of population upon the large but not unlimited resources of America and of the world.

Our National Farm

AS CITIZENS of the United States we own a large farm. In the aggregate we have 1903 million acres. Like the farms of many individuals, our national farm land is not all of equal productivity. Authoritative government surveys indicate that only 800 million acres can be cultivated even after the population has greatly increased and the demand for food is much larger than now. It is estimated that forests will permanently occupy 360 million acres; that 425 million acres will always be poorly improved pasture or range land; and that 238 million acres are destined permanently to remain desert lands; and that 80 million acres will ultimately be used for the purpose of cities, roads, railroads, and other purposes which do not produce agricultural crops. Thus 1103 million acres, or 5.7 per cent of our national farm, is destined to be used only for purposes other than production of food.

At present we are cultivating approximately 500 million acres. From the figures above given it is apparent that we can increase our cultivated acreage only 60 per cent. Since the national farmer, like the individual farmer, has doubtless used the best land first, the 300 million acres left to be cultivated are likely to produce very much less per acre than the land now used. An estimate that they may produce only one-half as much per acre as the land now used seems to be conservative. On this basis the United States can increase its food production only 30 per cent.

Though we now have some surplus, especially during the years of maximum production like 1925, let us assume that we use all of the food produced during the average year and then view our needs of the future. Remembering that our population is increasing by approximately 1.6 millions annually, it is apparent that in 1946 we will have a population of approximately 143 millions, provided the present rate of increase continues. In a short period of only twenty years our own people may therefore consume all of the produce of our fully-developed national farm, provided the remaining three-eighths is only one-half as productive as the five-eighths now in use. On a more liberal assumption that the remaining 300 million acres is equally as good as the land now in use, we could increase our production only by 60 per cent. This would be enough to feed a total of 176 millions, a population which we will reach in 40 years, provided the present annual increase is maintained.

Of the 300 million acres yet to be reclaimed, 30 million must be made productive by irrigation, 60 million by drainage, 150 million by clearing of forests, and approximately 60 million by dry-farming. Remembering the important fact that thirty to fifty years are required to complete the development of large irrigation projects, it seems to be a wise policy to continue the construction of reservoirs and irrigation works, looking toward utilization of all of the waters of the West for irrigation and allied uses, and thus further the possibility of cultivating all of the arable land in our national farm.

A Poor Excuse

IT IS the privilege—or the misfortune, as it may be construed—of the editor of such a magazine as this to read, during the course of a month, literally hundreds of editorial columns in which the newspaper men of all parts of the country have set down their opinions on questions of irrigation and reclamation; voicing their opposition to or advocacy of contemplated projects, their condemnation of certain policies and their vigorous championship of others.

In several of the editorial expressions which have punctuated the unsteady progress of developments in the Colorado River debate, there has been visible a most interesting slant of opinion from editors in other parts of the country than the southwest. Many of the editors in Oregon, Washington, and Idaho, for instance, are enthusiastic in their congratulation of the southwest, and the whole country at large, and their own particular section especially, when something happens to lend color to the expectation that the federal government may soon proceed with the development of the Colorado.

"It's a grand and glorious thing that the government is about to do," they chorus, when a cabinet member's endorsement, or a committee's investigation apparently brings action a little closer. But their enthusiasm is based, not on the benefits which they forevision as accruing to the southwest, or the country as a whole, from such developments, but upon the assumption that the precedent thus established will lead to similar expenditures by the government in their own territory.

It is not intended to belittle the feasibility or the merit of any northwestern project, either actual or contemplated, by this observation. We are just as much interested in the development of the water resources of the northwest as of any other section. But the editors of any section, in support of any project, are doing an unwise thing when they seize upon federal approval of some other project, in some other section of the country, as the reason why their particular pet project should have federal attention. The future of reclamation, if it is to be a success socially and economically, depends upon each project standing four-square upon its own merits, and demanding attention by its unimpeachable feasibility. Reclamation in the long run will not be retarded. Its progress will rather be stimulated and assured.

Some Current Decisions of Western Courts Involving Irrigation and Drainage

Introducing a New Department Instituted in Response to a Widespread Demand From Readers

By HANKINS & HANKINS

Attorneys for Glenn-Colusa Irrigation District, San Francisco

IN RESPONSE to a widespread demand from readers, MODERN IRRIGATION has instituted a new department devoted to Irrigation Law. Under a departmental heading will be presented, each month, a short synopsis of current judicial decisions throughout the western states concerning irrigation and drainage. This department will be conducted by Messrs. Hankins & Hankins, of San Francisco, attorneys for the Glenn-Colusa Irrigation District of California. This firm of lawyers is not only widely experienced in irrigation legislation, but is also a large land-owner in the Sacramento Valley, with the result that they view the theory of irrigation laws with an understanding of the practical necessities of farming.—Editor.

Liability of Directors of Drainage Districts

Directors are severally and jointly liable for trespass, even when such trespass is committed by them in official capacity.

The Appellate Court of California, third district, in the case of Newberry et al v. Evans, et al., 49 Cal. App. Dec. 393 (Feb. 10, 1926), holds that the directors of a drainage district in entering upon the property of a landowner without his knowledge, consent or approval, and digging a ditch across such property, causing damage, constitutes a trespass for which the directors are severally and jointly liable, even if the acts complained of were committed by the directors in their official capacity, and that the only proper method of procedure was either to obtain the consent of the land owner or commence and maintain proceedings in eminent domain as provided for by the constitution.

The drainage district was originally a party defendant but was later dismissed, presumably under the idea that a suit could not be maintained against a drainage district under the provisions of the statutes of 1903. These provisions are practically identical with those of Sec. 15 of the California Irrigation District Act. The appellant court holds this to be error, apparently on the theory that it was not a question of negligence of the directors and thus differentiates the case from Whiteman v. Anderson Cottonwood Irrigation District, 60 Cal. App. 234.

The court further states, however, that if the drainage district, as a consequence of the action against the directors, actually obtained the possession of the land for ditch purposes, and was using the ditch in the same manner as though authority had been obtained through eminent domain proceedings, then the directors were jusified in issuing a warrant of the district to pay the amount of the judgment obtained against the directors, no question of the negligence of the directors being involved.

The case was reversed with instructions to the trial court to allow such amendments as would bring all issues squarely before the court.

District's Responsibility to Utility Obligations

An irrigation district is held to have the right to take over a public utility system free of public utility obligations.

The Glenn-Colusa Irrigation District, situated in Glenn and Colusa Counties, California, was organized to take over an unprofitable public utility water system. As part of the plan application was made to the State Railroad Commission for leave to make the transfer free and clear of public utility obligations. On this hearing certain land owners who had refused to include their lands in the irrigation district, filed objections, but upon the hearing the Railroad Commission allowed the transfer of the properties but provided that the protestants would be allowed a certain time within which to join the irrigation district. The protestants insisted that they could not be deprived of their right of service from a public utility, claiming it to be a vested property right, refused to join the district and after demand for service proceeded to use the water. The district brings an injunction suit to prevent this unauthorized use.

In the case of Glenn-Colusa Irrigation District vs. Paulson, et al., 48 Cal. App. Dec. 460 (Nov. 3, 1925) the Appellate Court upholds the district's position in refusing to deliver water and the action of the Railroad Commission. It also reiterates the law laid down in the case of Jenison v. Redfield, 149 Cal. 500 to the effect that an Irrigation District cannot deliver its water for use on lands outside of the district.

It further holds that the right of service of water from a public utility does not bring the lands so furnished under the protection of Section 552, Civil Code, and such right of service is not a vested right or a right appurtenant to the land.

Effect of Agent's Admission of Liability

Verdict upheld where letter from agent admitting liability for damages had been admitted as evidence.

In the case of Trueman v. Sutter Butte Canal Co., 49 Cal. App. Dec. 242 (January 23, 1926,) a letter from the engineer of the Company was offered in evidence wherein it was stated "The Canal Company has contributed to some extent to the general seepage condition in the orchard, but the major portion of the damage is due to rice irrigation. The Canal Company is willing to assume $250.00 of this damage, being the amount of damage due to direct seepage from our canals. . . . " The introduction of the letter was strenously objected to by defendant but was admitted as "an admission by the defendant, through an authorized agent, that the defendant did contribute to the damage of plaintiff's orchard."

On appeal the question arose as to the correctness of an instruction to the jury where the court failed to allow the jury to consider any question of the manner of the construction of the ditch but in effect made the company an insurer against damage arising from maintaining and operating the ditch.

Appellants cite various cases showing that ditch owners are not insurers but the Appellate Court holds that they are not called upon to attempt to differentiate, even if it may be done, between the case cited and the instant case, as the instructions could not be held to have worked prejudice as against the defendant, in view of the fact that defendant (through the letter of its engineer) expressly admitted liability, at least in part, for the damage. The verdict of the jury was upheld.

Status of Unofficial Engineering Reports

Unofficial reports of engineers are not admissible evidence in condemnation proceedings.

In the case of City of Stockton v. Vote, 49 Cal. App. Dec. 315 (February 2, 1926), where the City was condemning lands for the purpose of constructing a dam to control flood waters and thereby submerge certain lands, a report of an engineer was allowed in evidence, without objections, but the Appellate Court held that it was inadmissible in evidence as being only an unofficial compilation of statistics and the opinion of the engineer.

Evidence was also introduced, over objections, as to the value of the property to the City of Stockton and the Appellate Court held that in a condemnation proceeding the necessities of the public are never taken into consideration in fixing the value.

The judgment was reversed but appellants were taxed with the costs of appeal as under the law a land owner is entitled to the full value of his land, when finally ascertained, exclusive of costs.

Districts' Powers Limited by Statute

Irrigation Districts have only such powers as are expressly given them by act of the legislature.

In the case of Bottoms v. Madera Irrigation District, 48 Cal. App. Dec. 366; 242 Pac. 100; (October 27, 1925) the plaintiff brings an action against the district to recover the sum of $176,000 for services rendered in causing a settlement to be made of the differences between Miller & Lux and the district. The so-called contract was repudiated by the district.

The court holds that the contract was beyond the power of the Board of Directors, ultra vires and void. It further holds that

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THE HYDRAULIC DIGEST

A Monthly Bulletin Board of Brief Facts and Events from Far and Near

Complete Antioch Reservoir

Citizens of Antioch, California, are rejoicing in the completion of the Antioch Reservoir, said to have solved the community's problem of water supply. The capacity of the reservoir is 60,000,000 gallons.

Would Sell Water Works

S. E. Throwell, owner and operator of the Lomita Water Works, serving Lomita Park, California, has applied to the railroad commission of that state for authority to sell the system to Daisy Noe.

Redlands to Vote on Bonds

Redlands (California) voters will ballot on April 12 on the question of whether the city shall bond itself in the sum of $525,000 for the purchase of the "Zanja," historic mountain irrigation stream, now owned by ranchers of the "old town" west of the city.

Plan Co-operative Project

Action has been taken by citizens of Ravenswood, California, for the incorporation of the East Almond Co-operative Water Company, a non-profit organization which proposes to develop water for the irrigation of lands owned by its members.

Bellingham Takes Over System

Bellingham, Washington, has taken over the operation of the South Bellingham water system of the Fairhaven City Power and Water Company. The system was acquired at a cost of $165,000, for which bonds were voted by the city. The bonds were purchased by local financial institutions.

May Buy City System

A committee has been appointed by the city trustees of the city of South San Francisco to make a study of the properties of the South San Francisco Water Company, with a view to reporting on the feasibility of its purchase by the city. The value of the property is appraised at $485,000.

Salt River Users Have Plenty

An official statement from the Salt River Valley Water Users' Association declares that there is no cause for alarm, in connection with the water supply for the coming year, on the part of water users in the valley. The statement asserts that the association has available at this time the same water supply as last year, and that the pumping system will adequately supplement the stored supply.

Water for Roosevelt District

First water was supplied to the lands of the Roosevelt Water Conservation District during February when a 1,000-inch pump began to pour water into the main canal of the district, taking its supply from the south canal of the Salt River Valley Water Users' Association. Three other large pumps will soon be in use at the intake, while the other pumps at various points will provide sufficient water to cover the 41,000 acres of the project.

To Build Ten Miles Levees

The Colorado River Land Company has called for bids on the construction of ten miles of new levee along the river east of the Volcano Lake Basin. The new levee will be an extension of the existing Pescadero Dike, running south from the Pescadero Dam, and will be built in connection with an additional two and one-half miles of new levee which is to be paid for jointly by the Imperial Irrigation District and the Colorado River Land Company.

Promissory Notes Authorized

The farmers Irrigation Company, Santa Paula, California, has been authorized by the state railroad commission to issue $55,000 of its unsecured promissory notes for the retirement of outstanding notes; $18,000 of additional promissory notes payable in three years; and $29,000 additional common stock; and to deliver the three-year notes and stock, together with $14,600 in cash, in payment for water properties recently acquired from the Limoneira Company.

Refuses System Purchase

City of Vallejo, California, has decided against the contemplated purchase of the Bay Terrace water system. Negotiations touching the transaction have been in progress since the city first undertook to purchase the system in 1921 and later declined to complete the deal.

Arizona Bonds Purchased

Sutherlin, Barry & Company, New Orleans, were successful bidders in the sale of the $112,000 bond issue of the New State (Arizona) Irrigation and Drainage District, consummated in February. The funds from the sale will be turned over to the Salt River Valley Water Users' Association for use in the development of the lands of the New State district, by means of a pumping project.

Enlargements for Moreno

Improvements undertaken in the water system of the Moreno (California) Mutual Irrigation Company will cost approximately $160,000, to be spent within the next four months, according to plans which the company announced in February. The improvements involve the construction of a pipe-line from the town of Moreno to wells on the company's property in the San Timoteo Canyon, including 31,000 feet of 24-inch steel pipe and re-inforced concrete pipe, and 2500 feet of short tunnels. It will carry water for the irrigation of 3500 acres.

Yakima Bond Sale Delayed

Water revenue bonds of the city of Yakima, Washington, in the amount of $1,050,000, which had been conditionally purchased by a syndicate of Seattle banking houses, ran into an unexpected delay late in February when the purchasing syndicate asked for an extension of sixty days in their preferential purchase rights. The attitude of the purchasers is that the water system contemplated under the bond issue is economically defective. They object to the use of wooden pipe in the distribution system, believe that the estimate of revenues was over-optimistic, and the estimate of operating expenses too low.

Irrigation Creates a New Industry

(*Continued from Page 12*)

years. A. J. Shamblin, Superintendent of the United States Date Experiment Station at Indio, has directed the work under the auspices of the Bureau of Entomology of the Federal Horticultural Board. The results have been very gratifying, and the final success of the campaign of extermination seems probable.

DATES ripen from September to December and attract thousands of visitors. To the average city dweller, a trip to the Coachella Valley during the harvest season seems like a visit to the Sahara or Mesopotamia. Graceful green palms bearing huge bunches of luscious fruit have a romantic appeal not found in other products of California.

The demand for California dates has kept pace with, and even surpassed the rate of production. This been due to several causes, the foremost being the excellent flavor of the fruit. The name of the person who first described Coachella Valley dates as "nature's finest confection" is unknown, but he deserves much credit for such a happy thought so well expressed. Inferior varieties, which are now in the process of being eliminated from the valley, or the lower grades of the standard varieties, do not, of course, fulfill the expectations of a purchaser, so care must be taken when a novitiate buys dates for the first time that he secures the best. In the United States the total consumption of both domestic and foreign dates last year was approximately half a pound per capita. This comparatively small amount indicates that the day of overproduction is far in the future.

A number of the smaller growers sell their entire crop fom their back doors or from road-side stands, others pack and ship their fruit to commission merchants in the larger cities. The major portion of the crop, however, is put through modern packing houses where great care is taken to prepare and pack the fruit in a sanitary manner. Cleanliness is another reason for the active demand now enjoyed by California dates.

The Deglet Noor Date Growers Association, with its headquarters and packing house at Indio, is a growers cooperative modeled somewhat after the orange or walnut growers associations. This association has a membership of 43 growers and the largest output of any similar organization. Deglet Noors are handled almost exclusively, the only exception to the "one-variety" policy being a few hundred pounds of Thoorys which are brought in by the members. The Thoory is considered the best of the "bread dates" and, being dry and hard, is easily handled.

The Narbonne Ranch and George Beach also operate well equipped packing houses in the valley, though not specializing in any one variety. Several packing houses have been established in towns near Los Angeles where dates from the Coachella Valley are prepared for the market. The Valley Packing Company has a large and modern plant in Monrovia, the Marvin Date Company has its plant in Riverside, the Date Corporation of America is located in Alhambra and the Cowgill-Conner Date Company has its plant near Pasadena. The two last mentioned also specialize in Deglet Noors.

AN INTERESTING feature of the date industry is the class of people who have adopted date growing as their hobby or their life work. It would be hard to find an industry where so high a general level of intelligence prevails. Professional men of all classes, business men from several different lines of work, (and women too, of course), skilled mechanics, farmers and citrus growers are all represented. About nine years ago, C. E. Cook, formerly in the electrical supply business in Los Angeles, secured a large tract of land in the Indian Wells district and started a date garden. Knowing that there were others who would like to own date gardens but who were prevented by business or other reasons from making developments personally, he sold portions of his land under contracts to plant and care for date gardens. Most of these palms are in bearing now and their owners are highly pleased with results. The list of owners includes a lawyer, a business woman, two high school principals and three others also engaged in educational work. Mr. Cook is now engaged in opening up another tract of land and it will be interesting to classify the new list of date enthusiasts.

Residents of the valley believe that sooner or later the waters of the Colorado River will be available for use and with the coming of cheap water that the Coachella Valley will enter upon an era of development that will far exceed anything that has occurred in the past. The rich soil will bear bountiful crops and eventually the Coachella date will take its place with the orange and the raisin, to be known all over the nation.

Why Are Our Irrigation Organizations?

(*Continued from Page 18*)

improvements and particularly public works? Should we, at this time, before constructing railroads, highways, and other improvements, along our public streams, give some consideration to the future hydraulic development that may be made thereon?

THIS institution is known as an Irrigation Congress, but I am sure we can now fully realize the value of water for other purposes and thus the necessity of coördination in the various uses to which it may be beneficially applied. We can therefore no longer consider irrigation development standing alone but must take into account the use of water for manufacturing, power, domestic and other purposes.

As our population increases the demand for wholesome, potable, domestic water becomes more important and as our industrial growth continues the value and need of energy likewise increases.

The use and protection of our watersheds now largely given over to national forests and open public domain presents a problem of importance quite aside from the question of grazing, which is now pending before Congress for a solution.

We are confronted with hydraulic and water supply problems of an inter-state nature that are demanding solution. The most immediately important of these exists on the tributaries of the Columbia River, Pend d'Orielle, Priest and Coeur d'Alene Rivers and lakes of the same name. The state is called upon to outline its future needs and to enter into a compact with three other states, effecting an allocation of this water supply among them and dedicating the same to various uses. The solution of this problem requires careful study, the exercise of keen judgment and mature foresight.

It is a question whether this Congress is the proper organization to give these problems attention and whether it can function in a capacity which will find a solution for them. In a government such as ours, these, and most other public questions, must after all find a solution in an expression of public sentiment. This being true, if we are to arrive at a proper solution, some means must be employed to give the public the facts.

Our legislature convenes once every two years, each session being confronted with many requests and suggestions for laws designated to outline the conditions under which our natural resources may be utilized. These cannot, without a previous crystallization of public senti-

ment, receive adequate and properly coordinated consideration.

UNDER the laws and constitution of Idaho as they now exist, neither the state nor any of its institutions has a right to say whether a proposed use of water resource is really in the interest of the state and constitutes the greatest possible beneficial use to which it might be put. Perhaps this is a wise provision but on the other hand I am inclined to the belief that it is a matter that warrants our careful consideration. Can we, under this condition, expect to complete the development of our water resource and secure the greatest benefit from it to the state as a whole?

These problems are not limited to the state of Idaho. It is my belief that they will find a correct solution only through some organization or institution dedicated to unselfish public service. You gentlemen should come to some conclusion at this session as to whether or not there shall grow out of the Irrigation Congress an organization dedicated to a solution of these problems.

Irrigation in Colorado

(*Continued from Page 19*)

function. Of a truth it may be said that Colorado is pre-eminently an agricultural state, but all this as a result of her irrigation institutions. Is it, then, passing strange, that with her future inseparably joined with this great industry, she considers her water supplies her greatest asset, and looks anxiously ahead to the safe-guarding of this precious heritage which means so much to her people? For upon the successful protection and administration of this, her greatest resources, depends her present prosperity and the future development of her tremendous potential resources, which is of such vital importance to Colorado, and of material moment to the nation at large. Those pioneers in irrigation practices and jurisprudence who framed Colorado's constitution and laws builded wisely and well for the safe-guarding of this great industry, a monument to their sagacity, a blessing to her people, and a bulwark to a nation.

To Investigate Extension

Citizens of Cle Elum, Washington, were greatly interested by the suggestion made before a service club of that city by Superintendent Lytel of the Yakima project favoring the extension of the proposed Kittitas high-line canal as far as Cle Elum, to irrigate 5,000 acres of land lying east of the city, and to add to the municipal supply. Funds for an investigation of the possibility of obtaining such action have been appropriated by the city.

Federal Reclamation Spending $25,000,000 in New Work

Reclamation under federal control is spending approximately $25,000,000 in new construction of dams, canals and irrigation works on twelve different projects, according to an official report, which declares that the work now going on is the largest to be undertaken since the original major projects were built.

Three large dams, the McKay dam on the Umatilla (Oregon) project, the American Falls dam, Idaho, and the Guernsey dam on the North Platte River are the largest of the works now under construction. In addition to these dams, construction work is in progress on a number of other federal projects.

On the Yuma project, a 1,200 horse power hydro-electric plant is under construction, at a drop in the California main canal. This plant will cost about $250,000, and will furnish power for pumping water to the Mesa division lands in Arizona. The foundation of the plant has been completed and the contractor has commenced the erection of the power house.

On the Grand Valley project, Colorado, a siphon spillway is being constructed at the Orchard Mesa pumping plant, and excavation is also being carried on with draglines at a number of points in connection with drainage work at a cost of $200,000.

On the Boise project in Idaho, riprap is being placed for the bank protection and a concrete parapet is being constructed on the main canal in order to increase its capacity, the cost being $278,000.

On the North Platte project the enlargement of the Interstate Canal is in progress and the construction of the Laramie River diversion canal is under way at a cost of $465,000.

On the Carlsbad project, New Mexico, concrete lining of the main canal is in progress and on the Rio Grande project in the same State several dragline excavators are being utilized in the construction of drains, levees, and canals, the total cost being $1,016,830.

On the Klamath project in Oregon, enlargement of a number of canals is in progress at a cost of $58,700.

On the Yakima project, Washington, canals are being lined with concrete on the Tieton division, and a wasteway is being reconstructed on the Sunnyside division, the cost being $65,000. On the Kittitas division rights of way for 27 miles of the main canal are being purchased and specifications are being prepared for the early letting of contracts that will involve an estimated expenditure of $7,500,000.

On the Riverton project in Wyoming, construction of the Pilot Butte dam embankments are in progress together with some lateral excavation. The Pilot Butte dam embankment will be 42 feet high, 2,400 feet long, and contain 200,000 cubic yards of material. Its cost will total $189,000.

On the Shoshone project in Wyoming, contract work is in progress on the Willwood division for the construction of canal and laterals at a cost of $290,000.

Recent Court Decisions

(*Continued from Page 22*)

irrigation districts are public corporations or agencies, and have only such powers as are expressly given them by the Legislature, under and by virtue of which they exist, or are necessarily implied to carry out the purposes of the district. That any one dealing with the district is chargeable with knowledge of all the powers that officers of such district possess, and all contracts beyond the scope of such powers are void, and knowledge must be taken, not only of extent of power, but also the mode in which it may be exercised.

Transfer of Moneys Between "Funds"

The changing of money from one fund to another by an irrigation district does not change the true status of such money.

In the case of State vs. District Court, 242 Pacific 431, (December 23, 1925) the Supreme Court of Arizona held that the Board of Directors had no authority to transfer money from the construction fund of an irrigation district to a so-called "hold back fund" or other fund except where there is a surplus upon the completion of the district project.

The mere direction of the district to the County Treasurer by the resolution to designate portions of this fund by some other name and the compliance by the Treasurer with this direction by bookkeeping entries in her records, did not change the status of the fund. It still remained the construction fund, although called by other names.

Irrigation Bonds General Liens

Under Oregon laws, the bonds of irrigation districts are general lien obligations.

In the case of Noble v. Yancey, 241 Pac. 335 (Dec. 2, 1925) the Supreme Court of Oregon held that under the statutes of that State, bonds of an irrigation district are general lien obligations, requiring the assessment of all the lands in the district for the payment of principal and interest, which necessarily requires the assessment of each current year to be sufficiently broad to take care of actual and contemplated delinquencies in prior assessments.

The Oregon law differs from the California Irrigation District Act in having a special provision in its act providing that "In case the amount assessed against any tract of land shall not be paid the next assessment against the land in the district shall be so increased as to take care of such default," but the court holds that this section did not change the prior and general law to the effect that the liens of the bonds are general liens against the lands of the district. The case also distinguishes certain decisions which held that the liens of irrigation district bonds were not general liens.

HYDRAULIC ENGINEERING

Dealing with the Practical Problems of the Operating and the Consulting Engineer

CO-OPERATING IN SURVEYING OUR WATER RESOURCES

How the States and the U. S. Geological Survey Work Together

By N. C. GROVER*

OCCASIONALLY great excitement is caused by the discovery of a rich gold field, resulting in a rapid migration of adventurers who hope to make fortunes by mining. Discoveries of gold or other precious metals lead men to undergo hardships and danger in order to take a chance on being lucky enough to "strike" a rich mine, and yet, over a period of years, the average annual value of the gold taken from the ground is insignificant in comparison with that of the products of agriculture or manufactures.

Water, a mineral that is even more valuable than gold, is so commonplace that its value is often overlooked. In fact, it is only in connection with a shortage of water that its value is appreciated by many people. When that condition is reached and especially when water is seen to limit development along any line, as it now does in this country along many lines, there is a demand for the collection of reliable data in regard to the nation's water resources.

The total amount of water available for use in any region cannot be increased, except here and there, by diversions from nearby rivers. Its distribution throughout the year may be modified by means of storage, but the total quantity is a direct result of precipitations which cannot, so far as now known, be changed by any act of man. This statement applies with equal force to ground waters which also are derived from precipitation. The variability in the flow of streams from month to month and year to year, and the inability of anyone to predict with confidence what the future flow of any stream may be, except by study of records of the past behavior of that particular stream, have forced engineers to conclude that reliable records of flow of many streams ranging in size from the largest to the smallest are absolutely essential to safe and sane development along many lines.

WATER has always been recognized as a necessity for both plant and animal life and deficiencies in supply were first recognized as important in connection with irrigation. Suitable and adequate water supplies for cities and towns have for many years required the services of the best engineers of the country. More recently, the marvelous growth in the use of electric energy has brought strikingly to attention the limit which the available water supply puts on the size of power plants, both hydro and steam, and has shown that the amount of water in a region determines the limits of development of industries, the growth of cities and in many regions the extent of agriculture.

For the design of hydraulic works that are to remove water, a knowledge of the maximum amounts to be removed is just as essential as is knowledge of the amount of water to be used or to be controlled for the design of hydraulic works that are to promote use or control. Everyone who has to do with water, whether to use or remove it, needs, therefore, reliable records of the quantities available or to be removed at all seasons.

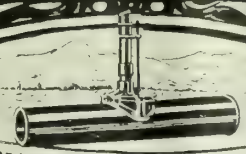
Under continued Federal appropriations extending over 30 years, the United States Geological Survey has become the authorized Federal agency for collecting and publishing data pertaining to water and is the recognized source of reliable information in regard to all questions relating to water supply. As the Survey, which is primarily a Bureau of research and investigation that collects and publishes for general information and use data in regard to the natural resources of the country, has been unable to extend its water resources investigations to keep pace with the need for data, governmental and private agencies have sought its cooperation in extending the investigations of water supply. This cooperation has increased greatly in recent years and now involves thirty or more states.

More than $500,000, in addition to the regular Federal funds, has been contributed annually in recent years by states, counties, municipalities, and corporations operating under the Federal Water Power Act. Twenty-five district and sub-district offices are maintained by the United States Geological Survey for carrying on field work. An experienced engineer and competent assistants are assigned to each district and by residence there make themselves familiar with local problems and needs and facilitate conferences with local cooperating officials.

A few state officials have felt, at first, that their problems did not require the collection of complete records; that they were interested, perhaps, only in the floods and, therefore, needed only the records of high stages, or only in the low flow and needed to study only the periods of draught. All have now learned, however, that if reliable records at particular stages are needed, the river station must be established, rated carefully and maintained continuously, because otherwise the records of extreme stages either will not be collected or will be insufficient for correct interpretation into quantities of discharge at the peaks or into total run-off in the flood season, the two quantities that are always needed. In general, the equipment and the personnel must be ready and functioning regularly or records of extreme stages, which are the most difficult to collect and interpret, will not be made. In flood seasons, the combination of impassibility of highways, interrupted railroad schedules and shortness of peaks of floods makes the collection of flood records, except as a part of complete records, difficult, expensive and disappointing.

AFTER varied experiences with the many different problems that arise, most states have recognized the advantages to be obtained by cooperating with the United States Geological Survey, which has a staff of trained engineers qualified by experience and furnished with all needed equipment of the latest and best design, to collect reliable records at a minimum cost. Besides its large force of engineers who study the

*Mr. Grover, who is chief hydraulic engineer for the U. S. Geological Survey, presented the accompanying article as a paper before the recent National Drainage Congress at Oklahoma City.



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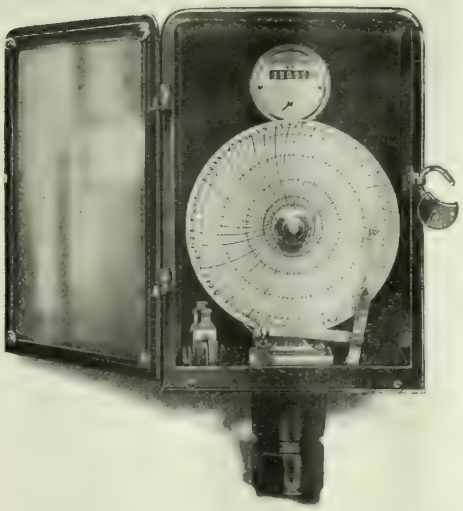

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surface waters, the Survey has a corps of ground-water geologists experienced in the problems related to the occurrence and recovery of ground water, and, in addition, a group of chemists trained for studying the chemical quality of water with respect to its use in agriculture or the industries, and a chemical laboratory especially equipped for this work.

The nature and terms of the cooperation vary as the problems and available funds vary in the several States. The amount of Federal money that can be allotted for cooperative use in any State is, however, generally no more than enough to pay the salary of the district engineer. The amount of work that can be done is wholly dependent on and nearly directly proportional to the amount of cooperative money that can be allotted.

In general, it is not practicable to attempt the establishment and operation of a district office with less than $10,000 annually in the total fund available for the work, and preferably the fund should be considerably larger. With that or a greater amount available, a district office is established in a state and an experienced district engineer put in local charge. The work to be done will be decided in conferences between the district engineer and the cooperating officials, the wishes of those officials being followed in general. The work having been decided on, its technical conduct will be entirely within the control of the officials of the Geological Survey who will select methods, equipment and personnel, having due consideration for costs of the work and the funds available therefor.

Federal funds are so meager that it is uneconomical to conduct work in a state that does not cooperate in a sufficient amount to warrant the establishment of an office. Stream gauging cannot be conducted economically or satisfactorily by engineers who live at a great distance from the work. The waste of time and money in travel is great, and the records collected will not be accurate because of the impossibility of having engineers on the spot promptly when needed and of the certainty that too little work will be done at the cost involved in sending men from a distance.

For several years past cooperation has been requested far in excess of the funds that the Survey could allot to the work. Because of this situation, there has been an insistant demand by State officials that Federal funds for studying water be increased. This demand has culminated in a bill, introduced in this Congress by Honorable W. H. Newton, of Minnesota, providing for an inventory of the water resources of the country to be made by the United States Geological Survey in cooperation with States and other governmental agencies and authorizing annual Federal appropriations of $500,000 in each of 20 years except the first when $400,000 is authorized.

The bill was drafted and is sponsored by the American Engineering Council and has the endorsement of Federal bureaus, cooperating State officials, many local and national engineering societies, and engineers in private practice who deal largely in problems relating to water. The Council has summarized the reasons why this inventory should be made by and in cooperation with the United States Geological Survey as follows:

1. The Geological Survey is primarily a bureau of research and investigation that collects systematically and publishes for general information and use data in regard to the natural resources of the country and it is recognized as an authorized Federal agency for collecting and publishing information in regard to all questions relating to water resources of the country.

2. The Geological Survey has an established personnel and facilities for carrying on the investigations. The methods used in conducting the work have been developed as a result of years of experience and have been accepted as standard throughout the United States, and foreign countries. This insures co-ordination and standardization of all investigations conducted by the Geological Survey or under its supervision.

3. The work of the Geological Survey is on a continuing basis and is reasonably free from danger of interruptions with changes in administration.

4. The Geological Survey is in position to make data readily available to the public by means of its publications and of other facilities.

5. It is highly important that base data in regard to water and other natural resources be collected by an unbiased agency not directly interested in construction or administration of specific projects or of specific types of projects in order that the public may have absolute confidence in the results. Moreover, agencies responsible for construction or administration are most soundly fortified if their actions are based on information collected by an accredited federal investigational bureau whose primary responsibility is that of making available unbiased facts.

An Outline of Irrigation

(Continued from Page 14)

Our past work in determining the laws governing the flow of water in canals and other conveying channels used in reclamation is recognized as authoritative not only in this country but in foreign countries. The work of this Division along lines of canal operation and maintenance, reclamation organizations, canal and ditch structures, water requirements of soils and plants, alkali reclamation and the drainage of irrigated lands together with many other lines of research already mentioned or that will be mentioned, constitute the field which we have occupied in reclamation during the past thirty years. It has been our effort to guide the irrigator with a view of making his position more profitable and secure.

For Detailed Listings, Branch Offices, Etc., See the Buyers' Guide to Leading Supply Sources—Pages 55-56

Diesel Power as One Solution for Drag-Line Difficulties

By JAMES O. QUILLER

RECLAMATION contractors, engineers, and other users of excavating equipment are exhibiting more than ordinary interest in the application of Diesel engine power to small draglines, shovels and similar excavating equipment so widely used on hydraulic projects.

"It should have marked advantages, undoubtedly, over some of the power units used on shovels and ditching machinery," said a well known contractor to me, during the recent Western Road Show at San Francisco; "but I shall want to be convinced that the chief objections to the Diesel have been entirely overcome. The idea itself, of course, is not original; it has been simply a question of adapting the Diesel to this use or that, wherever practicable, but for many purposes we know that this type of plant has not yet qualified—for use on automobiles, for example."

With the view of clearing up the main points of doubt, as to precisely how the Diesel performs when used on a dragline machine, and how this latest innovation is proving up in the hands of users, I went directly to the manufacturers, the Northwest Engineering Company of Chicago. C. R. Dodge, general sales manager of the company, in his reply tells how vibration—one of the major objections to the Diesel as heretofore applied to the dragline, because confined to three cylinders—has been eliminated, and explains many other features of interest to dragline operators.

"For years," says Mr. Dodge, "the material reduction in the cost of operation has been the goal sought by every manufacturer of shovels, cranes and draglines. The Diesel principle of internal combustion has offered the nearest approach to real economy, but to date the excessive bulk and vibration of the Diesel has made it a questionable form of power for shovel, crane or dragline service.

"For a long time the Northwest Engineering Company, the largest exclusive builders of gasoline and electric shovels, cranes and draglines, has given consideration to the Diesel and its relation to this class of machinery. This concern was not willing, however, to put such an engine on the market till able to overcome those common troubles in the present small Diesel. Excessive vibration must be eliminated, complete combustion assured, and many of the mechanical difficulties corrected.

"After five years of experimentation and study on the problem of the Diesel, the Northwest Engineering Company has announced the Northwest-Cummins Diesel Engine. Unlike the oil engines now being placed in service on shovels, cranes and draglines of from ¾ to 1¼ yd. capacity, the Northwest-Cummins utilizes 4 cylinders. Thus all objectionable vibration has been eliminated and smooth operation is assured."

"The Northwest - Cummins," continues Mr. Dodge, "is a real Diesel in every respect, not a semi-Diesel, and it brings all the advantages of the original Diesel principle unmodified, as in the case in the many solid injection engines at present on the market.

"It starts from stone cold, without the aid of torches, electric hot spots or other similar device, and runs at a full Diesel compression of 500 lbs. pressure. This assures full economy of operation.

"This, as well as the complete combustion without the use of the troublesome high pressure air compressor, is accomplished by means of the peculiar and novel means of fuel injection. The fuel pressure is only 50 lbs. This makes possible the use of needle valves of the simplest type and allows the most accurate metering.

"Air is actually injected with the fuel, as in the original Diesel, but instead of coming from a high pressure air compressor it comes from the combustion chamber itself on the compression stroke.

"The 4 cylinders of the Northwest-Cummins are cast separately, allowing easy removal of either half of the five main bearings as well as the easy removal of any cylinder with minor alterations to the rest of the machine.

"All parts are extremely sturdy and heavy. The fuel pump is very simple and serves the purpose of keeping the pressure up to 50 lbs. only, and not as a fuel meter as is the case in most small Diesels. Operation is cool, the water jackets never approach the boiling point, even after hours of work on hot days. Lubrication is full pressure feed throughout and is carried to the piston pins.

"For starting, a small gasoline engine and an air compressor are provided. The compressor charges a small storage tank that has capacity for from 10 to 15 starts. Twenty minutes daily operation will keep this tank full.

"The primary advantage of this engine is of course low cost of operation. Northwest machines equipped with the Northwest-Cummins are operating at a cost of 90 cents a day."

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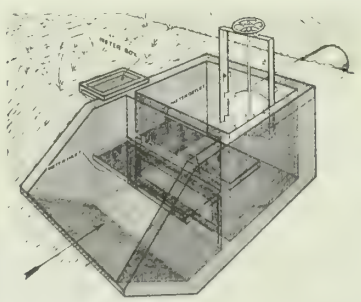

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MANAGEMENT

GAS ADVOCATED AS FUEL FOR IRRIGATION PUMPING

By F. M. BANKS

THE CLAIMS and costs of electric power for pumping irrigation water have been given in previous issues of MODERN IRRIGATION. *In this article F. M. Banks, sales supervisor for the Southern California Gas Company, presents the case for gas, which he asserts is a superior source of power under certain conditions, and which is widely used in irrigation, especially in southern California. The article is a much condensed abstract of a paper which Mr. Banks delivered before the Pacific Coast Gas Association in February.*

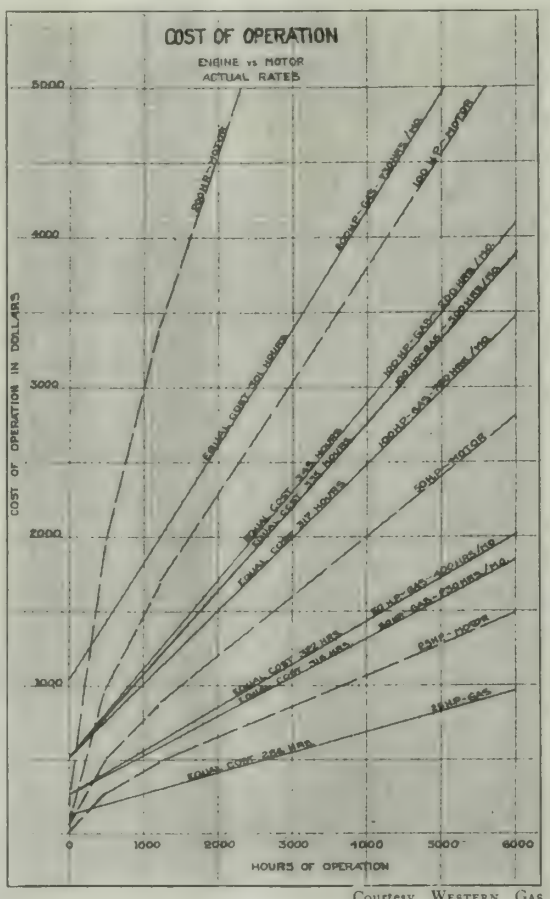
IN SOUTHERN California a relatively large portion of the water required for irrigation must pumped. Furthermore, there are some areas in which the water level is quite low, often exceeding a depth of 200 feet below the surface. The prevalence of these conditions is responsible for the installation of a large number of gas engines for this work.

At the present time there are almost 400,000 active gas engine horse power connected in Southern California from Bakersfield south. In the last few years installations have been made at the rate of about 50,000 horse power per year. In 1925 the increase was nearer 75,000 horse power. A good portion of this horse power operates continuously in oil company and gas company work. The remainder, something like 25 per cent, is used in agricultural and industrial work.

POPULARLY, gas engines are considered unreliable, subject to shutdown from numerous causes, liable to excessive repairs, difficult to start and subject to constant attention. All of this is the result of experience with old types of engines using liquid fuel, of high speed engines on constant loads, and of the uniformly sad experience with engines operating on continual overload. These impressions are kept fresh in the minds of power users by salesmen for other equipment.

As for shut down, data collected for a year in one case discloses the fact that engine shutdowns for all causes were about one-seventh of the shutdowns of electric motors, and the time of shutdown was in about the same ratio. One installation of nineteen 160 horse power engines driving compressors experienced forced shutdown due to both engines and compressors of only 0.2 to 0.3 per cent. Thus, engines are proven to be one of the most reliable sources of power. Repeat installations by concerns who have operated engines 24 hours a day for the full season is proof of the success of gas engines.

Experience has taught us that engines 20 to 30 years old will operate season after season with very small repair bills. Properly cared for and given proper replacements, engines will operate much longer, so that salvage value at the end of 20 or 25 years is considerable. Never the less, we often figure the life of an engine as 20 years, showing depreciation in the statement of overhead as inseparable from repairs. That is, an engine will depreciate much faster than it otherwise would, if adjustments and repairs are not made as needed. Therefore, allowing 20 years for the life of the engine, depreciation and repairs should be taken as 8 per cent a year.



Courtesy WESTERN GAS

Gas engines are always equipped these days with an air starting unit, so that starting is far from difficult.

The four outstanding features of improvement made in recent engines, namely, high tension ignition, forced feed oiling, throttle governing, and air starting, have so changed engine operation that modern engines are no longer comparable with old engines. Further than this, proper muffling makes operation possible even in the cities.

It is a surprise to those not acquainted with the facts to see how little is the attention required by gas engines. Frequently one man operates several plants a mile or more apart and attends to other duties, such as water company zanjero, in addition. This is possible because the fuel supply is constant, gas does not foul the engine, and the design is such as to afford safe continual operation.

For our purpose engines usually encountered may be classified as follows:

1. Slow speed engines with head and mixing box designed for gas.
2. Slow speed engines converted from liquid fuel to gas.
3. High speed engines of tractor type.

4. Automobile engines using gas as fuel.

The most economical, and in the main the most satisfactory engines are the first class. Converted engines can be made to operate fairly satisfactorily from a point of fuel economy, but conversion must be properly done. Too often this is not given attention, and only mediocre results are obtained. These engines will operate on gas as they stand, but with a high fuel consumption. Because of the fact that they have been designed to give rated power with a practical maximum of power from the fuel-air mixture at compression pressures in the neighborhood of 80 pounds per square inch the gas-air mixture is slow in burning. The explosive power of the mixture is not utilized and combustion often continues to the point of exhaust. It is therefore necessary to increase compression pressure to 100 or 110 pounds, by inserting a plate bolted either to the piston or to the inside of the head.

High speed engines will not as a rule be satisfactory on constant load, the fuel economy is not good and more constant attention, and more periodic care and repairs are required. Low first cost of course often makes it feasible to operate such engines and replace them oftener than would be necessary with heavier engines. This is true particularly of old automobile engines, picked up at small cost. However, from the standpoint of the utility they are not satisfactory. It is too easy for the owner to become tired of having to attend to such an engine and install a motor. With years of service from a heavier engine the owner is himself the utility's best protection for continued business.

IN COMPARISON with liquid fuel engines, and not here considering Diesel or semi-Diesel engines, gas at 40 cents per thousand is equal to liquid fuel at about 3.6 cents per gallon. It is apparent that gas, where available, has the engine field largely to itself.

On the average, gas engines properly installed, with air starting unit, muffler, gasometer and so on, complete and ready to operate, cost from $55.00 to $66.00 per available brake horse power. Electric motors with starting and protective devices cost in the neighborhood of $15.00 per horse power. Of course the prices per horse power vary with the size of the plant, but a comparative price of four to one may be taken as a fair average for the purpose of discussion.

In addition to first cost, a new installation may, for example, require a larger house for an engine than for a motor. Further, an engine may be chargeable with additional labor. In most cases, however, a pump must be attended to periodically, in which case

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In the preface to the third edition, (1926) Dr. Fortier writes: "During the decade . . . the practice of irrigation has been much improved, the farmers' part in irrigation better understood and appreciated, and fundamental principles more fully elucidated. To record these changes aright, and to present the knowledge that has been gained, . . . it has been necessary to add a number of new articles, and to rewrite and enlarge much of what appeared in the earlier editions."

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the operator may see that the engine is functioning properly and go about his work. The proper sort of engine in this case should require no extra labor charge. In water companies, additional labor may be an item of some moment, or may be cared for by paying the present attendant a slight increase in salary, or it may amount to nothing.

It is easily seen that conditions peculiar to the individual case will determine the charges which apply. In actual work it is of primary importance that all conditions be investigated thoroughly before an engine is recommended. Otherwise an engine may be installed where it will not be satisfactory from a point of economy. In this case injury to the engine business will result far out of proportion to the importance of the particular installation causing the trouble.

COST of operating includes the following:

Fixed Charges: a—Interest, b—Depreciation, c—Repairs.

Operating Charges: a—Fuel, b—Lubrication, c—Labor.

As for interest, much has been said. The fact that the Government does not allow of charging interest on invested capital when figuring deductions from taxes should seem to support the contention that to charge interest in a statement of comparative costs is unfair. In a business the matter is quite apparent. If a man invests in his business he expects a return which will warrant that investment. Otherwise he would put his money out at interest. In other words he is being paid for his business risk and business management. In the case of an engine, the owner installs it only after he has satisfied himself that it will pay for itself in the assumed period of life, and will net a return over and above that amount. Otherwise he would better use a motor.

Therefore, since the engine is paying for itself and also netting a return, it is fair that a depreciation fund should be established. If this is not done the money is being used for something else and should be expected to be able to earn the usual interest rate at least. Hence, setting aside, on the books at least, 5 per cent of the first cost each year, and creating it with the normal interest earning power, the total interest earned for the period of the life of the engine will just equal interest charged against the engine year after year as it depreciates.

A good engine may be expected to give a thermal efficiency of about 25 per cent and a mechanical efficiency of 90 per cent. Properly designed, an engine will develop a brake horse power of 9,500 to 10,000 B.t.u. With 1000 B.t.u. gas the

(*Continued on Page 53*)

Oil Man Turns Farmer

C. F. Whittier, wealthy Californian, who recently retired from active participation in the oil industry after seventeen years as president of the United Oil Company, has purchased two sections of land at Buttonwillow, California, near Bakersfield, and will begin large-scale farming operations. Plans of development include the drilling of eight water wells immediately and the installation of a complete concrete pipe irrigation system. Cotton will be planted on the larger portion of the land at first, but it is planned to grow lettuce and other vegetables later on. The land which Mr. Whittier has purchased includes Sections 21 and 22 and is a part of the large acreage being divided and and sold by Miller & Lux.

Contends for Legal Point

J. S. Higgins, city attorney of San Diego, has expressed his opinion that it would be illegal for the city of San Diego to permit the La Mesa Irrigation District to share in the costs of the El Capitan developments and to have part of the resulting water. Attorney Higgins' contention is that the $4,500,000 bonds voted by the city were expressly for municipal purposes, and the co-operative arrangement, which has been suggested by Judge M. W. Conkling, who is trying the city's case against the La Mesa district and the Cuyamaca Water Company, would be a diversion of the funds from the purpose for which they were voted.

Must Vote Again on Bonds

Orange (California) voted $125,000 in municipal water bonds last September, but, according to the opinion of attorneys consulted by the municipality, the question must be resubmitted to the voters because of the reading of the ballot in the September election. The proposition as approved included provision for the purchase of water stock belonging to the Santa Ana Valley Irrigation Company, and because the state constitution does not permit the state or any of its political subdivisions to subscribe for stock or become a stockholder in any corporation, the attorneys hold that the whole issue is invalidated.

Dr. H. L. Kent, president of the New Mexico College of Agriculture; F. J. Rigney, of the Elephant Butte Irrigation District; and L. M. Lawson, superintendent of the Rio Grande project; have been named by Hubert Work, Secretary of the Interior, as members of a Board of Examiners to assist in the determination of the qualifications of applicants for entry to public lands on the Rio Grande Reclamation Project in New Mexico and Texas.

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WITH THE WATER COMPANIES

Of Interest Expressly to Water Works Engineers, Superintendents and General Managers

SAN FRANCISCO STARTS NEW DIVISION OF HETCH-HETCHY

By HUGH CRANE

THE FOOTHILL division of the great Hetch-Hetchy project is the next section of that titanic construction task to be undertaken by the city and county of San Francisco. The foothill division is one of the higher links in this great system that will eventually bring to San Francisco a water supply from the snows of the Sierra Nevadas sufficient for the needs of a population of four million, and will generate electrical energy estimated at 200,000 horsepower.

The highest of the ten divisions into which the project is divided is the canyon division or Lake Eleanor division, which extends from the Lake Eleanor reservoir, at 4,660 feet elevation, to Early Intake, where the aqueduct begins, at elevation 2326. The next highest division is the Mountain division, which includes the 19-mile continuous tunnel, and drops from 2326 to 2170 feet in that distance. The next division is the Moccasion division, the shortest of the ten segments of the project, but one of the most important, as the generating point for power. These three have been completed, and the next to be taken up is the Foothill Division.

THIS DIVISION extends from the Moccasin Power House, where 100,000 horsepower is developed, through the foothills a distance of 17 miles to the eastern side of the San Joaquin Valley at the Oakdale Portal. It includes 16½ miles of tunnel aqueduct and one-half mile of pressure pipe passing under the Tuolumne River and Don Pedro Reservoir. It drops from 924 feet, the elevation of the nozzles at Moccasin Power house, to 741 feet at Oakdale Portal.

Camps are now being established along the seventeen miles of the course of this division, shafts are being sunk, and the engineers in charge hope that within a month the work will be ready for bidding by contractors.

The tunnel through the Sierra foothills below Moccasin Creek for which the plans of this division call will be divided into two sections at the Tuolomne River by the Don Pedro Reservoir at Red Mountain Bar. The siphon under the reservoir is already constructed, having been completed in 1923. It is an inverted steel pipe siphon cased in concrete. This construction was not required for several years to come, but as the river channel at the crossing was to be flooded by the reservoir constructed by the irrigation districts of Turlock and Modesto, the lower portion of the siphon submerged by the lake was constructed in advance of filling the reservoir.

This section, with the ends extending well above the elevation of the dam crest, is of riveted steel pipe, 9 feet 6 inches in diameter and 771 feet long. The thickness of the steel varies from ¾ inch to 9-16 inch. The interior of the pipe is lined with cement mortar 2¼ inches in thickness, leaving the net diameter 9 feet 1½ inches. The pipe is laid on bedrock and is incased in concrete from 18 inches to 2 feet in thickness. The siphon is designed to carry the entire flow of the aqueduct of 400 million gallons per day.

A camp accommodating 100 men, and a plant including tramway, bunkers, etc., were constructed on the west side of the Tuolumne River near the crossing. Excavation was started in the main channel in November, 1922, the water being diverted by means of a cofferdam around the work. This section was rushed with all possible speed. Early fall rains hampered the work and in December, when 12,000 second feet of water passed down the river, a small section of the cofferdam was washed out. After concreting this first section of pipe, the river was turned back into its channel over the pipe and a cofferdam thrown around the east channel. No unusual difficulties were encountered on the remainder of the work and the siphon was completed and tested on June 1, 1923, in time to permit the Modesto and Turlock irrigation districts to close the gates of the Don Pedro Dam and fill the reservoir for that season's irrigation.

THE WORK now to be undertaken will add the 16½ miles of tunnel and will complete the division, marking the completion of the project from its extreme point to within 117 miles of San Francisco.

It will mark the realization of another definite step toward the eventual goal, the project which has been called the city's greatest asset, and which has been gradually evolving since the beginning of the century. Actual construction work has been going on for more than ten years. In addition to the three highest sections, the lowest part of the aqueduct, the bay crossing division, has also been completed, making the foothill section the fifth to be undertaken. Its cost is to be borne by a bond issue of $10,000,000 authorized by a vote of 20 to 1 at a special election in 1924.

San Francisco is already receiving a return from the large investments which have been made thus far, in the form of an income from the sale of power at wholesale rates near Newark, amounting to $2,000,000 a year, which pays the interest on more than $30,000,000 of the investment. This power is generated in the Moccasin division, where, under existing conditions, a delivery of more than 70,000 horsepower on an average is assured.

THE MOCCASIN division is one of the most interesting parts of the entire project. After passing through the 19-mile tunnel the water is delivered to Priest reservoir, the regulator for the Moccasin power plant. This reservoir was formed by the construction of an earth-fill dam 1,160 feet long, and 147 feet high, containing 717,283 cubic yards of earth and rock and 17,043 cubic yards of a concrete core-wall, at a cost of $1,000,000.

Water released from the reservoir passes through a concrete lined tunnel 13 feet diameter, 5,370 feet to a surge shaft 40 feet diameter, 160 feet high, from

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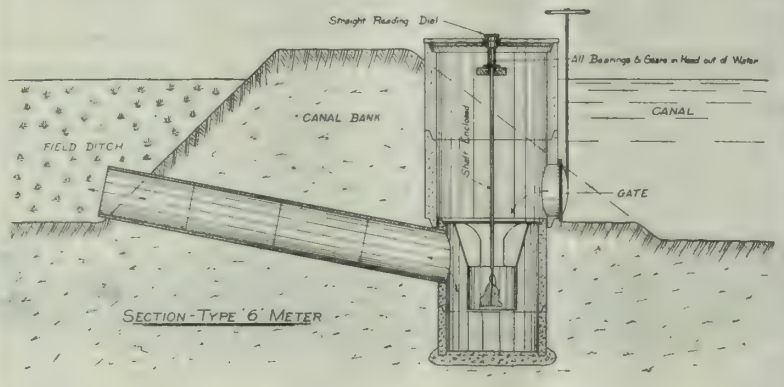

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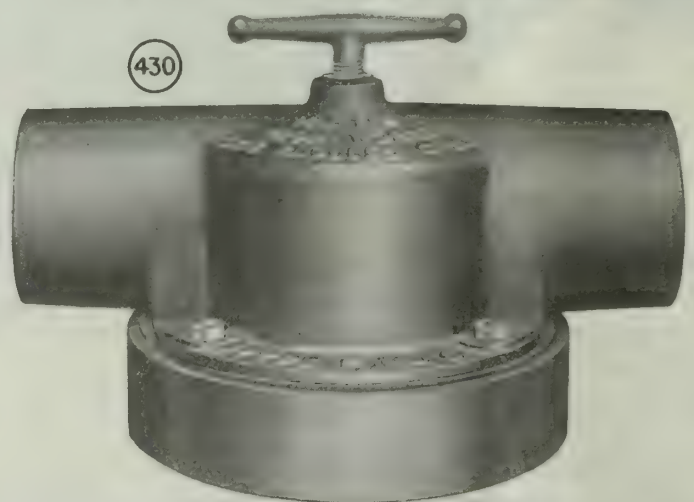

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which three pipes, 104 inches diameter, lead through branch tunnels in which they are imbedded solid in concrete.

One of the pipe is capped at its tunnel portal, to be extended in future, and two of them continue on down the mountain side branching to eight nozzles which shoot solid jets of water 11 inches in diameter against the buckets of the impulse type wheels which turn the generators of the Moccasin Power House. These four machines will deliver at full load 100,000 horsepower or 80,000 kv-a.

Balancing Reservoirs

(*Continued from Page 17*)

be equal to the corresponding annual cost of operation of storage reservoirs, expressed as a percentage of the peak demand. Having found this balanced cost condition and it is deemed desirable to store water in elevated reservoirs, the pressure conditions in certain selected zones should be scrutinized and the average pressure per hour plotted, as shown on Chart "E," from which the proper elevation of stored water can be obtained.

RECORDING pressure charts are almost indispensable in the pressure survey, and should be carefully adjusted, and proper calibration maintained. I find it convenient, in a study of this kind, to determine the elevation of these gauges referred to City Datum from which the elevation of hydraulic grade at any point on the system is noted, and comparison made.

Referring to Chart "B" again, attention is directed to the hourly pressure, and a suggested method of determining the dimensions, and elevation of elevated reservoirs for this particular case. If the tank is to operate automatically, and fill from the mains during the off peak hours, and discharge during periods of large draft, then the bottom of the reservoirs should be placed at such an elevation that a reasonable pressure head will be maintained until the heavy draft has stopped, and the pressure raises in the mains to the point of filling the tank. Sufficient friction head should be allowed between the pressure head in the mains, and capacity line in the reservoir so that the tank will fill rapidly during the off peak hours. An estimate of the required friction head, can be obtained by again turning to the mass diagram. It will be noted that the lines B-B are drawn parallel and tangent to that portion of the mass diagram which indicates the night flow. The rate of flow for this period is seen to be about 12,500 g.p.m. for the two 24 hour periods studied. If reservoirs are provided in the amount of 2¼ m.g., then they also must be filled during this period which will increase the night rate of flow by the time

decided upon to fill the reservoirs. An estimate can then be made of the allowable time to fill the reservoirs from which the proper friction head can be determined.

Summary and Conclusions

That before an extensive construction program is undertaken for a city, in which the problem is one of pumping from the underground waters, and the consumption of water is relatively high, the water department would do well to make a comprehensive study of the rate of growth in the past, and forecast the future conditions which are likely to be met. Based on this study then, pumping plant sites should be selected and the distributing system so designed that balancing reservoirs of economic capacity may from time to time be added. It is believed that balancing reservoirs of suitable capacity based upon economic study can be provided to equalize the maximum hourly demands throughout the year, thereby allowing pumping plants to operate at a higher average annual load factor, resulting in better efficiency and corresponding saving in power.

Reservoirs in the form of elevated tanks, or stand pipes, are easily constructed and maintained; their economy in annual costs offer a solution in many cases, as a method to meet the peak conditions, and their adaptability to smooth out the major fluctuations in pressure is recognized. An altitude valve or other automatic device should preferably be installed in the discharge line of the tank, thereby allowing complete automatic behaviors.

Frequently a slight elevation can be found in cities, even though the general topography is assumed to be flat. In this case there is sometimes experienced some difficulty in serving consumers, particularly on the peak. This case can be treated separately, and the district isolated by means of check valves in the trunk supply lines, and storage provided sufficient to care for the demand, based on local studies, rather than the system condition. It is obvious that the check valves should be so located, and the tank at such an elevation, that flow during off peak hours will store the water and be ready for use when the next cycle of lowering of system pressure occurs.

Stored water is also an asset from the point of view of fire protection, and should be given some weight in this consideration, more so perhaps if the entire supply is being pumped, than if from a gravity source.

Regarding the aesthetics of elevated tanks and towers, it seems to me that much can be said in this respect, and the conventional design of elevated tanks and steel towers so modified as to fit in with the surrounding buildings and structures.

Section of the 20 mile 60" steel aqueduct Hetch Hetchy Water Project. This line coated inside and outside with Biturine Enamel

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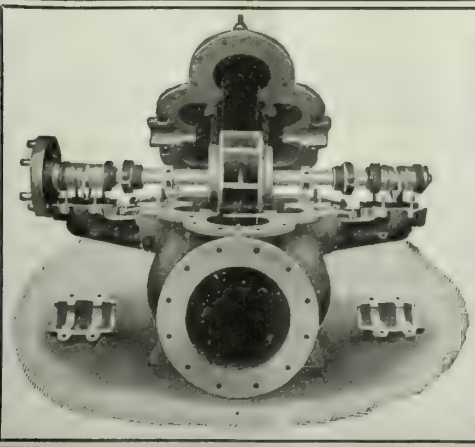

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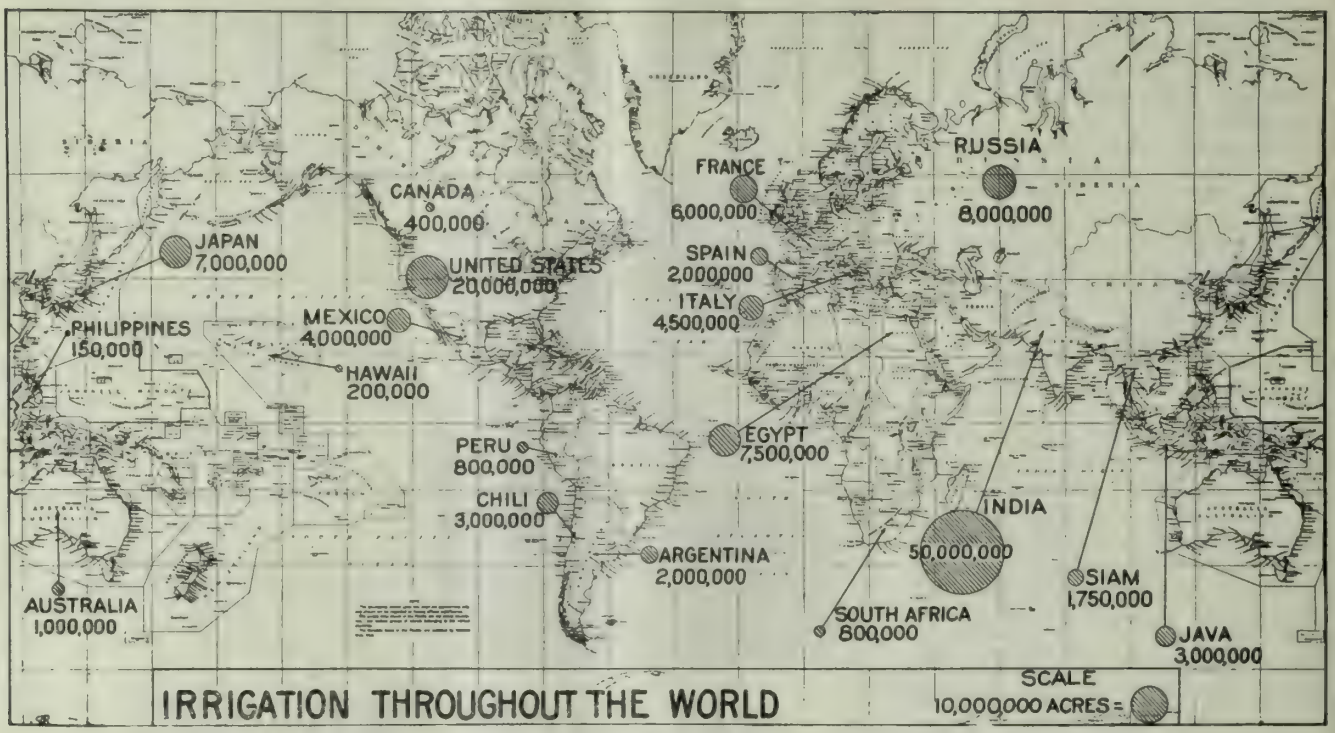

India Holds Lead in World's Irrigation Race

INDIA, popularly conceived as a backward land of tigers, turbans, and whirling dervishes, where the babies are fed periodically to the voracious Ganges, continues to hold the first place among the countries of the earth in point of irrigated acreage, as may be observed in the diagrammatic map on this page (reprinted from the NEW RECLAMATION ERA).

A steady increase of the area under irrigation in India is indicated in the Triennial Review, recently published by the Indian Department of Labor and Industries, which gives statistics on the amount of land under irrigation by government works. Figures are given for the three-year period of March 31, 1921, to March 31, 1924, and, while more than a year old in point of time covered, are the latest official calculations available.

Three quarters of a million acres were added to the area under government irrigation during the period under review, the total of lands in British India irrigated annually by government works of all kinds being 27,500,000 acres at the end of the period as compared with 26,750,000 acres during the preceding three-year period.

By years, the area irrigated totaled 27,578,308 acres in 1921-22, 28,302,303 in 1922-23, and 26,539,390 in 1923-24. In general, the results were as good as or better than those obtained the previous triennium, the notable exception being the United Provinces, where the monsoon was favorable in each of the three years. Productive works averaged 19,652,514 acres during 1921-24 as compared with 18,589,760 during 1918-21.

An interesting comparison of the acreage of crops matured during 1923-24 by means of government irrigation systems with the total area under cultivation shows that nearly 12 per cent was irrigated. The figures, by provinces, are as follows:

AREA IRRIGATED AND TOTAL AREA UNDER CULTIVATION IN 1923-24

	Net Area Cropped Acres	*Area Irrigated Acres*
Madras	36,424,000	6,891,000
Deccan	39,000,000	418,000
Sind	4,134,000	3,427,000
Bengal	22,806,000	93,000
United Provinces	35,011,000	1,979,000
Punjab	26,731,000	10,207,000
Burma	13,857,000	1,730,000
Bihar and Orissa	24,665,000	954,000
Central Provinces	17,427,000	438,000
Frontier	2,593,000	359,000
Rajputana	281,000	16,000
Baluchistan	286,000	26,000
Total	223,215,000	26,538,000

The total capital cost of government irrigation and navigation works up to the end of 1923-24 reached the enormous amount of 892,500,000 rupees (1 rupee equals $0.3666 at current exchange) yet in that year alone the value of irrigated crops was estimated at 1,400,000,000 rupees or over one and one-half times the total capital expended on the works. The percentage of area irrigated to total cropped area varied greatly in the various Provinces. Sind occupied first place with nearly 83 per cent; the Punjab came next with 38 per cent; and Madras, the Frontier Province, and Burma followed with percentages of 19, 13¾, and 12½, respectively. None of the others exceeded 10 per cent.

CONSTRUCTION of new works continued in practically all the Provinces during the triennium under review. In the Bombay Deccan the Girna River works in the Nasik collectorate were completed nad these, together with the Godavari and Pravara canals, are gradually coming into operation, while the Pravara River works and the Nira right-bank canal, incorporating respectively the Bhandardara and Lloyd (Bhatgar) Dams, are nearing completion and are already contributing to the irrigation of considerable tracts of country. Projects under consideration include the remodeling of the Mutha canals, the extension of the Gokak Canal, and a scheme for developing the Nira Valley by widening the Nira left-bank canal and constructing a new dam at Vir, to supplement the supply of water from Bhatgar. In so far as the Sind is concerned, all irrigation works have been dwarfed by the Lloyd (Sukkur) Barrage project, but a considerable number of improvements, nevertheless, have been and are still being effected. Projects for canals at Ghotki and Mahrani are under consideration.

The Riddle of the Rio Grande

(*Continued from Page 15*)

The Mexican government expressed full sympathy with the proposal, but suggested, as a counter proposal, that the scope of the commission be enlarged to include the Colorado river as well. Thus the matter stands at the present time. If the Mexican government maintains this attitude, the United States is in a helpless position, so far as the Rio Grande is concerned, for nothing can be done without the consent of Mexico. The American development on that stream will not only have to be arrested, but it will be menaced by possible development on the Mexican side.

PHYSICAL CONDITIONS favor the diversion of water on this Mexican side above the intakes of all the systems on the United States side. There is very good reason to believe that large irrigation undertakings are imminent in Mexico and it seems certain that it is a question of time only until Mexico will begin to take water out of the Rio Grande for irrigation of a portion, at least, of her valuable lands.

If this is done before additional supplies are developed by storage, it will seriously menace the present development on the American side and almost certainly cause a severe water shortage.

The users of water on the American side of the Rio Grande are not unappreciative of the fact that the interests of Mexico demand that she have water for the development of her lands—water to which she is entitled from every standpoint. They are, however, determined that their interests in the lands which have been already developed shall be protected, and are looking desperately for the solution of this problem—a solution which apparently requires an international agreement authorizing the construction of storage works.

Into this complex situation another factor has entered—a factor involving another international stream and the development of another great irrigated empire. Because of the similarity of conditions on the Rio Grande and the Colorado Rivers, the people of Texas have become intensely interested in the discussion revolving around the Colorado, and the various plans which have been put forward as the basis for its development.

In the second installment of this series of two articles, I am going to describe the conditions which link the destinies of these two rivers, and explain why the people of the lower Rio Grande Valley are vitally concerned with the plans for the proposed Boulder Canyon Dam and all-American canal.

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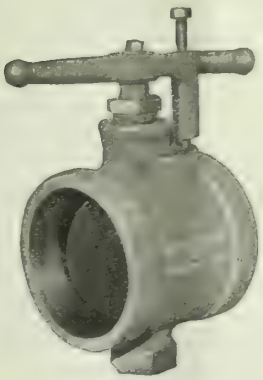

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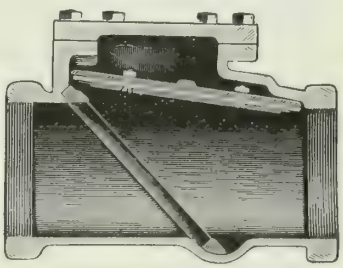

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RECLAMATION

WHAT CONSTITUTES A SUCCESSFUL COLONIZATION POLICY?

By DR. JOHN A. WIDTSOE*

Chairman, Northern Division, Board of Survey and Adjustments, Bureau of Reclamation

IN THE HISTORY of American colonization two ventures, conducted on a large scale, are of particular value in revealing the fundamental principles of successful colonization. The first of these is the settlement of the Great Basin and the Colorado River Basin by the pioneers of Utah. The second is the Federal venture in irrigation under the reclamation act of 1902.

The Utah colonization, which began in the valley of the Great Salt Lake in the summer of 1847, has spread, until settlements are now found in all the States of the Great Basin and the Colorado River Basin. Nearly all have met with unvarying success. Half a million prosperous people, two-thirds of whom are farmers, are carrying on the initial experiment of 1847. The United States Bureau of Reclamation has conducted its work in every Western State; more than 2,000,000 acres have been brought under water, and 200,000 people live on the lands reclaimed under the reclamation act. The history of those two developments should be helpful ot those who now are engaged in colonizing lands.

THESE experiences teach, first, that no enterprise in colonization can succeed unless the project is adequate to enable the farmer to meet his obligations and to live life properly in this day of high civilization. That crops can be grown is not sufficient evidence that a project is fitted for colonization.

The main question in colonization is whether the colonists, brought on the land, will remain on the land. The colonist-visitor injures a project; the colonist-settler determines its success. The test of a successful marriage is not the love of courtship days, but the love that persists after the wedding.

The experience of the Utah pioneers showed clearly that every colony placed on fertile land, with sufficient water supply, and under conditions enabling the reasonably industrious and thrifty farmer to live up to the standards of his day, was successful. When, by mischance, the people settled on infertile lands, or lands with insufficient water supply, or under adverse conditions beyond control, failure resulted.

In short, the farm must pay. Doctor Work's committee of special advisers on reclamation came to the same conclusion. Their most outstanding finding was that most Federal reclamation troubles could be traced to inherent conditions that made large areas incapable of satisfying the economic, social, and religious needs of the industrious, intelligent settler. This year's Board of Survey and Adjustments has confirmed this view by actually determining, by careful land classification, that a large proportion of Federal project lands is infertile or without water supply or unproductive for other reasons, and therefore incapable of producing crops profitably.

DR. WIDTSOE SAYS: The farmer especially must find his reward in the intangible realities. It is improbable that, in our day, the income from farming, counting the investment and labor, will be as large as in other industries. Agriculture is only in part a business; it is more a mode of living. To live in the open, to stand on one's own land, to labor independently of regulations, to match wits with nature and man; to raise one's family under conditions that breed strength of soul as well as of body—such spiritual rewards must compensate him for the lower cash income from his efforts.

The beginning of colonization wisdom is to make certain that the projects to which prospective colonists are invited are inherently capable of successful development. Projects which can not reward the farmer sufficiently to pay his obligation and to support his family in some comfort should be suspended from colonization efforts until such time as economic conditions change, or new knowledge permits a more profitable use of our resources.

A SECOND great colonization lesson taught by experience is that the prospective colonist must be selected according to his fitness to live and labor under prevailing project conditions. It takes a man of distinct gifts to become a successful farmer. In land reclamation, the farmer is the heroic figure. Capitalist and engineer must wait for their full rewards until the farmer by his unending toil has made the vision of the engineer and the dream of the banker come true. All men may love the land; but not all men can win a living from it. The margins of agricultural profits are small and the problems many and intricate.

Training in agriculture is not indispensable; it is desirable to have it. Many a city man has become a successful farmer; and, frequently, men with farm experience have failed as independent colonists. The test is, rather, love of the work and the ability to manage affairs intelligently.

The people who settled the projects of the Latter-Day Saints came from many countries. A large proportion came from industrial centers and knew little of agriculture. Nevertheless, the majority succeeded. The process of selection had secured, before they came West, a self-reliant people.

On the Federal projects all manner of men were invited to accept the new opportunities. The special advisers on reclamation found that many project troubles could be traced to the lack of selection. Men desirous of land ownership, but temperamentally or physically unfitted for the work, came on the projects only to fail.

THE third lesson taught by our colonization experience is that, though settlers are fitted for agricultural life, they must be given aid. Agriculture has become a complex art; no man can know all the facts upon which it rests. The

*An address delivered before the Conference on Reclamation and Land Settlement, Washington, D. C.

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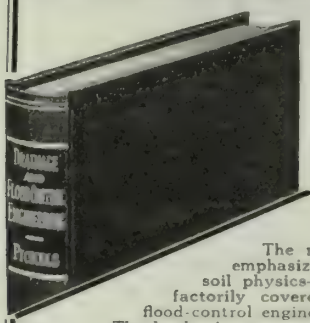

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By G. W. PICKELS
Assistant Professor of Drainage Engineering, University of Illinois

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farmer needs specialized help. The Federal and State Departments of Agriculture are making such technical aid generally available, but there is much yet to be done before every farmer can obtain necessary advice in time of need. Any plan of colonization should include provision for such aid.

The settler also requires financial aid. The man who has made a fortune elsewhere is seldom induced to become a colonist of a new project. Future colonization will be made largely with young men, ambitious for independence, but with little money. In the beginning, such men will require financial aid with which to build their houses and to equip their farms and, later, occasional help between harvests, until their growing bank accounts make further help unnecessary.

However, whether technical or financial aid is given, we must not, as a condition, compel the farmer to follow programs prepared for him. In successful agriculture, the farmer must preserve the independence of his actions; his work can not be planned for him. He must be a free agent. Nevertheless, the giving of aid, especially financial aid, enables those in charge of colonization to offer supervision and direction which the farmer usually needs, and nearly always accepts if given in the right spirit.

In the Utah settlements, the bishop and his two counselors stood at the head of a group numbering from 500 to 1,000 souls. These men were ready to assist in the material as well as in the spiritual needs of the people.

The history of the Federal reclamation projects shows without question the necessity of technical and financial aid, and that it should be given, not grudgingly but carefully, in a generous spirit. Wherever this has been done prosperity has come to the settlers.

There has come out of our settlement experiences the fourth lesson, that strong men on fertile, well watered lands and with ample aid, may fail unless they are properly organized for community life. Social are quite as important as economic needs. "Man does not live by bread alone." The colonization history of the country shows the desirability of community organization for social as well as for economic advantage.

The conditions of our day, involving many new demands, may compel future colonization enterprises to give such community organization first consideration. The value of the plan has been fully demonstrated by the Latter-Day Saints. The maintenance of a relatively small group of people, under a system of self-government, characteristic of the Mormon Church, serving the religious, economic and social needs of the people,

has contributed greatly to make the adventure in colonization successful.

The special advisers on reclamation found that community organization on the Federal irrigation projects had similar good effects. The settlers themselves had discovered it, and in many places had set about to form organized communities, out of which had grown a co-operative understanding and many successful co-operative enterprises. There can be no question about the importance of this lesson in future colonization.

Finally, a fifth lesson taught by our colonization experience is difficult to define, yet of first importance.

The success of the Mormon settlement activity, while resting upon a few simple principles, already outlined, was given life, strength, and permanence by a strong religious feeling. The things of the spirit are more important than those of the body. Spiritual forces cement the activities of mankind. Political, economic, and social forces are of secondary importance. In witness, we may recall that, in American colonization, the Church has always been utilized by those who have been most successful. Out of the communities held together by strong religious appeals, have come the leadership which has built rural America, and preserved our American institutions.

The farmer especially must find his reward in the intangible realities. It is improbable that, in our day, the income from farming, counting the investment and labor, will be as large as in other industries. Agriculture is only in part a business it is more a mode of living. To live in the open, to stand on one's own land; to labor independently of regulations; to match wits with nature and man; to raise one's family under conditions that breed strength of soul as well as of body—such spiritual rewards must compensate him for the lower cash income from his efforts.

It is doubtful if farming can ever be valued correctly on the basis of its money yield. There must be a spiritual purpose in every community, to make coherent and intelligible community activities. Life must be purposeful; else there will be no goal at which the community is aiming. Can we, of many creeds, as we continue our colonization, find an equivalent of the spiritual impulse? Can a community be made to feel the gain in the exchange of money for living? Perhaps, the best we can do is to see to it that the Church goes with the settler, so that he may be guided into visions of the great purposes of human life. However accomplished, it must be done. The acceptance of a coherent spiritual purpose in life is the most effective means of assisting a community to achieve success and happiness.

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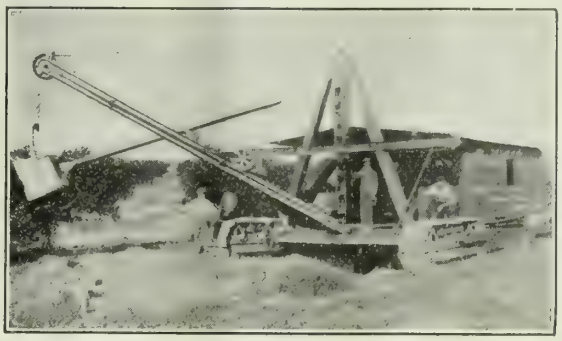

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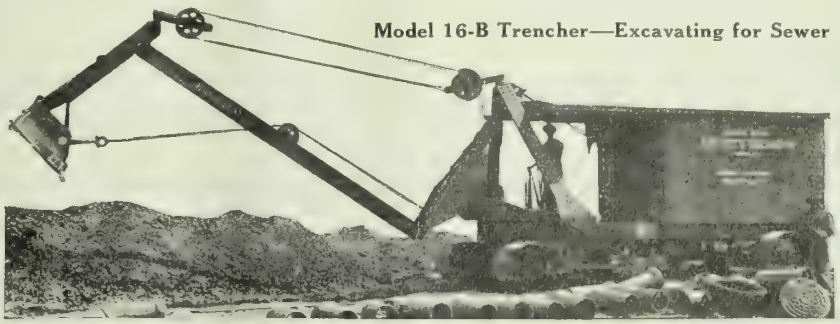

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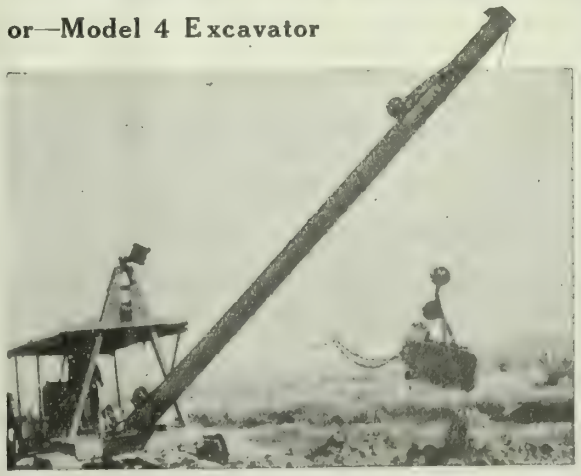

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IRRIGATION FINANCE

HOW TO FIGURE OPERATION COSTS AND INCOME ESTIMATES

By ORA McDERMITH
Consulting Engineer, Kittitas Irrigation District

IT IS obvious that the economic success of an irrigation project depends on the success of the average individual farmer or settler who secures the benefits from the construction of the irrigation system. The economic success of the individual farmer in turn depends on whether he makes a profit by his operations. That is, the average annual gross income over a reasonable period of years must exceed the average gross expenditures necessary in carrying on such operations.

In making an estimate of the feasibility or probable opportunity it is necessary to consider items of gross income and cost of operations in the average individual case in considerable detail. The more detailed the estimate usually the less chance of error will be encountered. In the making of such an estimate it is very convenient to have the outline in diagrammatic form, working from the result desired down through the various component items which produce such result and having each item capable of being further subdivided to its furthest detail.

The amount of the "Annual gross income" will depend primarily on the volume of production and the prices secured. Estimates of crop prices, costs and conditions should be based on data obtained from similar enterprises as to past performance and corrected for local conditions and possible future influences. Such estimates should be made with clear judgment and consideration of future conditions. For instance, on the Kittitas division of the Yakima project the primary established crops are alfalfa and grain, which, combined with dairying, offer a firm foundation for an estimate of the character of crops which probably will be grown with the added water supply. Yet there are areas on this division which, on account of air, drainage, location, and soils, undoubtedly will be devoted to commercial orchards and other high-priced crops if future prices for these crops justify the investment. Influences of this character should be carefully considered in the economic estimate.

As the income from farm operations becomes available to the farmer largely at the end of the crop season we should consider first the detail of "The annual cost of operations" and following this, "The annual gross income."

Cost of land and water supply.—The primary investment of a settler on an irrigated farm unit is in the land and the water supply necessary to irrigate such land. Usually the largest investment is in the water supply. This investment may be made all in one year, or, over a long period of years. Numerous methods of financing such investment are employed and the method proposed should be carefully analyzed in order to determine its effect on the annual cost for the period covered by the economic estimate.

The cost of the land should include the initial outlay for raw, uncultivated land plus the expense necessary to put such land into condition for the production of crops.

The raw land value is for the land in its natural state and consists principally in the value for grazing purposes. This should in most cases be but a nominal figure. After the land is smoothed for the first seed bed it is considered that subsequent operations will be included under the subdivision "Cost of producing crops."

THE ITEMS under the "Cost of land," are capable of further subdivisions according to character and other conditions. For instance, the item of "Clearing" generally depends on the character of work to be performed and can be subdivided as shown in the diagram. Each of these items is capable of further subdivision if required.

The "Cost of water supply" is an added investment to the "Cost of land" to make the combination productive by the labor of the farmer. It should include all costs which are for the purpose of insuring the permanency of the water supply.

Each of these items is likewise capable of extension as in the item of "Preliminary cost" as applied to irrigation districts which should include the expense necessary to bring the project to the point of construction of the irrigation system. This is an investment to make the land more valuable.

The item "Water purchase cost" in the diagram would be the purchase price of a given quantity of water. The item "Other water rights" includes supplemental supplies of some value owned or acquired in addition to, but separate from the main supply.

Cost of improvements. — The cost of improvements should include all expenditures of the capital investment which increase the value of the farm and make it more habitable.

Further subdivision of the item "Cost of buildings" is obvious.

For convenience the "Cost of general improvements" may be further subdivided, as indicated.

Cost of equipment. — The cost of equipment includes the yearly amount expended for tools, harness, and other items necessary to enable the farmer to carry on his operations efficiently. The grouping of these items is made thus on account of the common factor of relatively large depreciation.

Cost of livestock.—The yearly cost of livestock will vary greatly. As a general proposition most of the livestock will be raised on the farm, the offspring of progenitors purchased during the first few years of operation. Other cases may occur where the purchase of livestock is relatively large each year, especially where stock is bought annually for the purpose of feeding and fattening. Further subdivision of this item is obvious.

Cost of producing crops.—The cost of producing crops is one of the largest items of the annual cost on the irrigated farm. There are many methods for estimating this cost, depending on the grouping of the component factors. The further subdivision shown is illustrative of but one combination. The items as

shown in the diagram consist of the principal operations and are capable of much more detailed subdivision.

Other current operation costs.—Under this heading will be feed purchased for stock, insurance on crops and livestock, water, operation and maintenance charges, and miscellaneous (itemized).

Personal expense. — In the farming business unlike other business enterprises the home and living expenses are considered as an integral part of the operations. These may be subdivided as indicated.

Fixed charges.—Under fixed charges we include: Insurance on buildings, interest charges, amortization, and general and personal taxes.

Miscellaneous. — Under this heading place any item which can not be placed under the above subdivisions. Any item under this heading should be accompanied with an explanation.

Annual gross income includes all receipts or values which may be received on account of any farm operation, and may be subdivided as indicated.

The completed diagram summarizes the subdivisions clearly so as to avoid duplication and the omission of important items.

ANNUAL COST OF OPERATIONS

1. Land and water supply
   - A. Land
     - a. Raw land value
     - b. Clearing land
       - i. Sagebrush
       - ii. Willows and cottonwoods
       - iii. Cut-over lands
       - iv. Forest underbrush
     - c. Leveling
     - d. Plowing
     - e. Smoothing
2. Improvements
   - A. Buildings
     - a. Dwelling
     - b. Barn
     - c. Silo
     - d. Miscellaneous buildings
   - B. General improvements
     - a. Fences and gates
     - b. Irrigation systems
     - c. Domestic water supply
     - d. Sewage disposal
     - e. Roads and walks
     - f. Shade trees, shubbery
     - g. Depreciation
3. Equipment
   - A. Hauling equipment
     - a. Automobiles
     - b. Trucks
     - c. Wagons
     - d. Harness
     - e. Hayrack
   - B. Farming equipment
     - a. Tractors
     - b. Plows
       - i. Walking
       - ii. Sulky
       - iii. Ditching
       - iv. Two-way
       - v. Gang
     - c. Harrows
     - d. Mowers
     - e. Rakes
     - f. Drill
     - g. Stacker
     - h. Binder
     - i. Manure spreader

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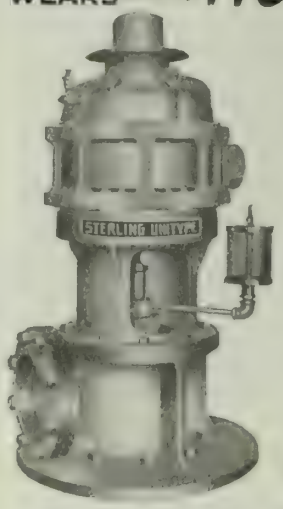

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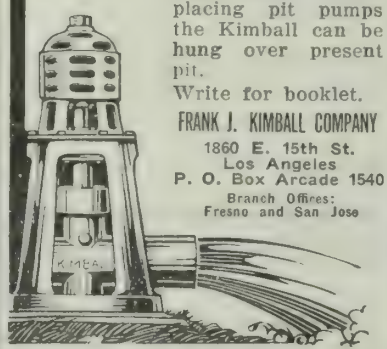

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e. Poultry equipment
f. Apiary equipment
g. Spraying equipment

D. Other machinery
a. Baling machinery
b. Threshing machinery
c. Winnowing machinery
d. Cleaning machinery
e. Miscellaneous

E. Depreciation

4. Livestock
A. Horses
B. Cattle
C. Hogs
D. Sheep
E. Poultry
F. Bees
G. Other livestock
H. Depreciation

5. Crop Production
A. Seeds and seeding
B. Irrigation
C. Spraying
D. Cultivation
E. Thinning
F. Fertilizing
G. Harvesting
H. Packing
I. Marketing
J. Miscellaneous

6. Other Current Operation Costs
A. Feed for stock
B. Insurance on crops and livestock
C. Water, operation and maintenance charges
D. Repairs and blacksmith
E. Veterinary
F. Miscellaneous

7. Personal Expenses
A. Household expenses and living
B. Life insurance
C. Medical and dental
D. Recreation, church, etc.
E. Furniture
F. Household equipment
G. Miscellaneous
H. Depreciation

8. Fixed Charges
A. Insurance on buildings
B. Interest charges
C. Amortization
D. General and personal taxes
E. Construction charge
F. Other fixed charges

9. Miscellaneous
A. Contingencies
B. Incidentals

Total Cost of Operation.....$.....

GROSS ANNUAL INCOME

1. Crop Sales
A. Orchard products
B. Grains and cereals
C. Hay
D. Pasture
E. Cultivated crops
F. Garden products
G. Small fruits
H. Miscellaneous

2. Livestock sales
A. Horses
B. Cattle
C. Hogs
D. Sheep
E. Miscellaneous

3. Dairy Products
A. Whole milk
B. Cream
C. Skim milk
D. Other products

4. Poultry sales
A. Poultry
B. Live birds
C. Eggs
D. Miscellaneous

5. Miscellaneous
A. Apiary products
B. Other products

6. Other income
A. Land sales
B. Land rents
C. Miscellaneous

Total gross income.....$.....

Deduct cost of operations.....$.....

Net income.....$.....

Cotton Profitable on Projects

Cotton valued at $21,393,000 was grown on five Federal irrigation projects in 1925. Cotton was grown on 215,967 acres on the Salt River project, Ariz.; Yuma project, Ariz.-Calif.; Orland project, Calif.; Carlsbad project, N. Mex.; and Rio Grande project, N. Mex.-Tex.

The yield from this acreage amounted to 83,011,470 pounds of lint and 163,759,794 pounds of seed, an average of 384 pounds of lint and 712 pounds of seed per acre. The total value of the crop amounted to $21,393,218, more than 27 per cent of the total value of all crops grown on the federal irrigation projects during the year.

The value of the crop on the Salt River and Rio Grande projects amounted to more than $8,000,000 each and acreaged more than $100 an acre. For the first time cotton was grown on the Orland project in California, where 64 acres were planted as an experiment. From this acreage cotton to the value of $5,625 was grown, or an average of $87.90 an acre.

Open Riverton Lands

Twenty farm units of public land on the Pavillion Division of the Riverton (Wyoming) project of the federal Reclamation Bureau have been opened up to settlers by the Interior Department. They range in size from 35 to 108 acres. Applicants for farms must qualify before the local board of examiners as to industry, character, and health, must have had two years farm experience, and must have $2,000 in capital, or its equivalent. Charges include $1.50 per acre to cover the cost of the land, spread over three years, and one dollar per acre for two acre-feet of water, with additional water at 50 cents per acre, for the seasons of 1926, 1927 and 1928.

For Detailed Listings, Branch Offices, Etc., See the Buyers' Guide to Leading Supply Sources—Pages 55-56

MODERN Irrigation

Are *You, Too,* Profiting From the Onward March of Reclamation?

AS RECENTLY announced in these columns, the Republic of Mexico, following the lead of the United States, has passed a "Reclamation Bill" and will expend $30,000,000.00 on some twenty irrigation projects.

The Grecian government, also, taking its cue from the success of such enterprises in America, India, Egypt, Australia and elsewhere, has determined upon a comprehensive program of reclamation and irrigation in Macedonia and will spend approximately $34,000,000.00 on this work.

It is a noteworthy fact that American engineering firms have been placed in charge of both of these undertakings.

Since America (the United States) leads in the manufacture of the most modern irrigation appliances, and auxiliary equipment of every description, the major percentage of these millions will in all probability (aside from labor costs) be spent within the boundaries of the United States.

American-made drag-lines, dredges, and other excavating machinery; trucks, tractors and automobiles; cement, cement re-inforcing and other materials; pipe and pipe fittings; gates and valves; motors and motor controls; meters and other odds and ends that go to make up a fully equipped irrigation project—these will have to be provided for, and the United States is the logical source of supply.

The advertising columns of MODERN IRRIGATION are the logical source of current information regarding such equipment. Engineers and other executives, who do ordering or specifying, will find these columns during 1926 a reliable "Who's Who" of manufacturers selling the hydraulic field. Here the leading, most progressive concerns in every line will be represented.

At this moment, the pages of MODERN IRRIGATION are being examined, and examined carefully, by men whose yearly purchases in *your* line aggregate large sums of money. Long-pull advertising will help you to secure a larger percentage of this annual turnover. The men who buy are reading and studying these advertisements—never doubt it. Consciously, or unconsciously, they are forming their opinions and narrowing down their ultimate choice of equipment. Many actual decisions are made months in advance of the order for the goods.

These projects are but two of the countless many under contemplation—or actual construction—at this time. Nineteen-twenty-six will be a big year in the irrigation and allied hydraulic industries. Millions will be spent for replacements and other millions for new equipment. Are YOU making your proper bid for a share of this business? Are you represented, as an advertiser, in the columns of MODERN IRRIGATION?

If not, phone, wire or write immediately for rates and complete information. Just say: "We wish to sell more equipment this year to the hydraulic field. How can MODERN IRRIGATION help us do it? Rush full particulars."

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OVERHEAD IRRIGATION

FOUR THINGS TO THINK ABOUT IN OVERHEAD SPRINKLING

Tillage of the Soil, Aeration of the Water, Clean Foliage and Frost Protection

By R. P. LEHR

IN THE February issue of MODERN IRRIGATION, *Mr. Lehr discussed three important considerations in overhead irrigation—its advantage in affording superior seepage, its adaptability to hillside irrigation, and the important matter of laying pipe for its installation. In this issue he continues the discussion, taking up four additional points which the man who uses, or is thinking of using overhead equipment should bear in mind.*

THERE is little doubt in the minds of agriculturists who are following sprinkler irrigation carefully that this new method of water handling will call for a more intensive cultivation. The furrower will be no longer necessary, but the furrower has been the means of breaking open the subsoil in a very beneficial way, when the furrows have been as deep as they should be. The change will call for more frequent use of the panbuster.

We also know that the sprinkling system will have a greater tendency to form a sole, or irrigation "pan" below the loose surface soil, than the old furrow method. We know that gravity water seeping down through the soil column carries with it the fine soil particles, which collect and compact themselves in a dense layer below the surface.

This, finally, in many soils, hinders water percolation and soil breathing of air, essential to bacterial life and chemical processes at work in the land. This is the most logical explanation we have of the so-called plow pans we often find in virgin prairie lands which have never known tillage of any kind. For this reason, we will have to make deeper use of the chisel cultivator, and for the reason that the sprinkler thoroughly wets the entire surface instead of only parts of it, some soils will experience crusting and baking at the surface when followed by conducive weather, and these factors will have to be offset by more intelligent use of cultivating implements.

THERE is one phase of overhead irrigation which I do not believe has been given due analysis. This is the special *value of aerated water*. There is an old saying among farmers that an inch of rain is worth more than an inch of irrigation water—this in spite of the fact that rain does not contain the soluble matter, which is often of beneficial character, that may be found in waters that have seeped through the soil to find their way into canals and wells.

But rain water does contain one desirable element—carbon—in the form of carbon dioxide, and in this it is unique. This may account for the benefit of rain water as compared with irrigation water. We know the value of carbon to all plant life producing a crop containing either starch or sugar, both of which are high in percentage of carbon. We also know the high percentage of carbon in the structure of the tree or plant itself.

THE SOURCE of this carbon is simply the atmosphere. Rainwater "washes" this gas out of the air to a degree depending on the size of the drop. Fine drizzle or fog is found to contain more carbon dioxide than rain drops, but will carry some carbon down to the soil from the higher air zones. From the soil it is then capable of mixing with the lower air and of being absorbed by the stomata, or breathing organs, found on the under side of leaves and in all green cell tissue, where— with the assistance of light—it is converted to starch and later to sugar in the plant chemical processes.

It may not be amiss here to say that our many classes of soil bacteria are cheifly responsible for the manufacture of this valuable gas, generated in the soil through the decay of vegetable matter by them, and the better we keep the soil aired and moistened, the better we promote the activity of these forms of bacteria. It may be true that some water will be lost through evaporation under the sprinkler system, but, in the writer's judgment, this is more than compensated by these other desirable characteristics.

An obvious result of the use of sprinklers is the fact that it keeps the foliage cleaner than other methods. The claim may be made that this results in keeping the tree foliage in better general physical condition. Grit which settles on the leaf from dust interferes with light reaching the choloroplasts, or cells where starch and sugar production reaches an important stage, for which light is essential. Nature intends that this surface be kept clean, and, except for unusual types, provides a waterproof gloss which permits foreign matter to be shed easily.

It has been pretty thoroughly demonstrated that insect pests can be substantially hindered by drenching the foliage of trees at regular intervals. I do not know how overhead sprinkling will affect propagation of mildew in crops susceptible to it. This is an item largely controlled by weather following the application of water or rainfall, and in the case of overhead irrigation, we should time our watering to fit in with favorable weather. This we cannot control in the case of rainfall.

The cherry is perhaps the chief crop that would present serious difficulty to the overhead sprinkler. When the cherry crop has advanced to a certain stage, drops of water should not be allowed to touch the fruit, for unless unusually favorable weather follows, the fruit will be injured.

THE CLAIM is often made that sprinkler irrigation is effective as a frost control measure. It is true that temperatures may be reduced by this showering of water. In fact, citrus fruit may be covered with ice by this process to a point where limbs will break. This measure will be safe as long as water is allowed to run, but it must be remembered that, if water is stopped after the ice has formed and the temperature continues to fall or to remain below the freezing point, the ice surrounding the fruit will take a temperature from the air which is even less than the freezing point of water. In other words, we would then have ice which is colder than freezing ice and this would draw upon the latent heat in the fruit until damage resulted. It is also a fact that this

system would permit a very quick means of reducing temperatures, and that the water, after reaching the soil, will fill it and this water in turn will assist in lowering temperatures by its radiation from the soil itself. Frost control is often greatly assisted by a large content of water in land irrigated previous to a freeze.

Overhead irrigation is a science so new that we have not yet learned all of its many phases. We have been at it long enough, however, to draw some fairly safe deductions and these point to its success if properly studied and applied. As the practice progresses we shall learn other lessons from it, many of them perhaps will be even more encouraging and profitable than those we have experienced in the last eight years.

Citrus Growers Discuss Water Matters at Institute

Irrigation of citrus groves provided the main theme of the annual citrus institute of Southern California growers, held at Santa Barbara in February, under the auspices of the citrus department of the Farm Bureau. Three hundred growers were in attendance.

F. H. Macpherson, widely known enthusiast for overhead irrigation, related his experiences in the use of sprinklers before the institute, discussing the benefits and limitations revealed by his investigations.

F. J. Veihmeyer, of the College of Agriculture, University of California, discussed soil water problems, asserting that losses of water by capillary rise are not as important as previously believed. Conservation of moisture by dust mulches is no longer imperative, he believes, in view of the fact that the greatest losses of water are through the transpiratory activities of plants. In this regard, the elimination of weed growth is of extreme importance. W. M. Mertz, prominent growers and investigator of Ontario, related experiences and conclusions on the efficient handling of field irrigation, his lecture being replete with practical handling of field irrigation, and suggestions on irrigation economics and efficiency.

Defeat Mokelumne District

The proposal to organize the Mokelumne River County Water District in the Lodi-Lockeford-Woodbridge-Acampo section of California was defeated by the voters in an election held March 4, by a majority of 917 to 465. The election was the result of agitation in favor of a water district for the protection of the supplies of the district from appropriation by other interests.

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SURVEY *of* HYDRAULIC DEVELOPMENT

As Shown by Official Records of the Month -- Local, State, and Governmental

Permits Issued

Among the more important permits to appropriate water issued by the Department of Public Works, Division of Water Rights of California, during the month of February, 1926, were the following:

Permit No 2414, Application No. 3895 (Eldorado County) Issued to Tahoe Electric Power Co., c/o E. D. N. Lehe, Sacramento, Calif., February 9, 1926, for 320 acre feet per annum from Star Lake in Sec. 30, T 12 N, R 19 E. Sec. 11, T 12 N, R 18 E. for power purposes in Sec. 11, T 12 N, R 18 E. Proposes to develop 357 T. H. P. Estimated cost $2,000.00.

Permit No 2416, Application No. 4573 (Tulare County) Issued to San Joaquin Light & Power Corp., Fresno, Calif., February 11, 1926, for 6 cubic foot per second from Wilson Creek and Morehouse Creek Springs in Sec. 32, T 20 S, R 31 E. and Sec. 30, T 20 S, R 31 E. for power purposes in Sec. 22, T 20 S, R 30 E. 1049 T. H. P. to be developed Estimated cost $11,500.00.

Permit No 2417, Application No. 3712 (San Bernardino County) Issued to Wm. Erwin, Pine Knot, Calif., February 11, 1926, for 0.05 cubic foot per second from Lone Mountain Spring in Sec. 31, T 2 N, R 2 E. for domestic use in Sec. 20. Estimated cost $5,000.00.

Permit No. 2418, Application No. 4009 (San Bernardino County) Issued to Big Bear Realty Corp., Los Angeles, Calif., February 11, 1926, for 0.025 cubic foot per second from unnamed spring in Sec. 31, T 2 N, R 2 E. for domestic use in Sec. 24, T 2 N, R 1 E. Estimated cost $10,000.00.

Permit No. 2419, Application No. 4385 (Sacramento County) Issued to North Sacramento Land Co., Sacramento, Calif., February 15, 1926, for 8 cubic foot per second from American River in Sec. 32, T 9 N, R 5 E. for use for irrigation of 640 acres near point of diversion. Estimated cost $15,000.00.

Permit No. 2420, Application No. 4836 (Sacramento County) Issued to North Sacramento Light & Water Co., Sacramento, Calif., February 15, 1926, for 12.4 cubic foot per second from American River in Sec. 32, T 9 N, R 5 E. for municipal purposes in North Sacramento and suburbs. Estimated cost $25,000.00.

Permit No. 2421, Application No. 4387 (Stanislaus County) Issued to Charles F. and Lottie B. Rose of Empire, Calif., February 15, 1926, for 0.25 cubic foot per second from Tuolumne River in Sec. 6, T 4 S, R 10 E. for irrigation of 20 acres in Sec. 6. Estimated cost $1,000.00.

Permit No. 2422, Application No. 4555 Modoc County) Issued to John A. Kresage, Adin, Calif., February 16, 1926, for 1.01 cubic feet per second from Ash Creek in Sec. 22, T 39 N, R 9 E, for use for irrigation of 91 acres near point of diversion. Estimated cost $750.00.

Permit No. 2424, Application No. 4755 (Siskiyou County) Issued to D. G. Weisz of Happy Camp, Calif., February 17, 1926, for 0.45 cubic foot per second from Bear Creek in Sec. 33, T 15 N, R 8 E, for irrigation of 36.05 acres near point of diversion. Estimated cost $600.00.

Permit No. 2425, Application No. 4584 (Inyo County) Issued to Paul N. Nunn etc., Deep Springs, Calif., February 19, 1926, for 10 cubic foot per second from Deep Spring, Buckhorn Spring and 32 other springs in Sec. 3, 9, 16, T 8 S, R 36 E. and Sec. 32 and 33, T 7 S, R 36 E. for irrigation of 1560 acres and stockwatering near points of diversion. Estimated cost $15,000.00.

Permit 2426, Application No. 4682 (Inyo County) Issued to Burchard Fine of Coso Junction, Calif., February 19, 1926, for 1.0 cubic foot per second from East Sacatar Creek in Sec. 21, T 22 S, R 37 E, for irrigation of 120 acres and domestic use near point of diversion. Estimated cost $800.00.

Permit No. 2428, Application No. 4832 (Mendocino County) Issued to Agnes C. Thomas of Ukiah, Calif., February 23, 1926, for 0.99 cubic foot per second from Russian River in Sec. 16, T 15 N, R 12 W, for irrigation of 79.24 acres near point of diversion.

Permit No. 2431, Application No. 4412 (Lassen County) Issued to J. J. Fleming, Wendel, Calif., February 25, 1926, for 4500 acre feet per annum from Secret Valley Creek in Sec. 36, T 31 N, R 14 E, for irrigation of 2033 acres near point of diversion. Estimated cost $6,600.00.

Permit No. 2434, Application No. 4820 (San Joaquin County) Issued to Walter A. Perry, Stockton, Calif., February 27, 1926, for 2.53 cubic foot per second from Old River in Sec. 29, T 1 S, R 6 E. for irrigation of 203 acres near point of diversion. Estimated cost $4,000.00.

Applications Filed

Among the applications for permit to appropriate water filed with the State Department of Public Works, Division of Water Rights, (California) during the month of February were the following:

Application No. 4908 (Yolo County) Chas. S. Luce, Box 155, Sacramento, Calif. for 2.86 cubic foot per second from Sacramento River, tributary to Suisun Bay. To be diverted in Sec. 1, T 10 N, R 3 E, M. D. M. for irrigation purposes on 229.1 acres. Estimated cost $3,500.00.

Application No. 4909 (Siskiyou County) Montague Irrigation District, Box 275, Montague, Calif. for 5 cubic feet per second from Little Shasta River, tributary to Shasta River. To be diverted in Sec. 26, T 45 N, R 5 W M. D. M. for municipal purposes in City of Montague. Estimated cost $8,000.00.

Application No. 4911 (Butte County) Charles Bloom, Box 69, Richvale, Calif. for 2.65 cubic feet per second from ditch "B" of Drainage Dist. No. 200, tributary to Sacramento River via Butte Creek. To be diverted in Sec. 22, T 19 N, R 2 E. M.D.M. for irrigation of 105.9 acres of rice in Sec. 22, T 19 N, R 2 E M.D.M. Estimated cost $1,000.00.

Application No. 4912 (Siskiyou County) Montague Irrigation District, Box 275, Montague, Calif., for 50 cubic foot per second from Little Shasta River tributary to Shasta River. To be diverted in Sec. 26, T 45 N, R 5 W, M.D.M. for irrigation purposes on 15,000 acres in Montague Irrigation District. Estimated cost $300.00.

Application No. 4913 (Humboldt County) James Marshall, c/o C. W. Rastall, Supt. Hoopa Valley Agency and school, Hoopa, Calif., for .45 cubic foot per second from Hostler Creek, tributary to Trinity River. To be diverted in Sec. 13, T 8 N, R 5 E. H. M. for irrigation purposes on 36 acres on Sec. 14, T 8 N, R 5 E. H. M. Estimated cost $1,000.00.

Application No. 4916 (Yuba County) Yuba River Power Co., 235 Standard Oil Bldg., San Francisco, Calif., for 15,000 acre feet per annum from North Fork Yuba River, tributary to Feather River. To be diverted in Sec. 24, T 18 N, R 7 E. M. D. M. and Sec. 22, T 16 N, R 6 E. M. D. M. for irrigation and domestic purposes.

Application No. 4919 (San Joaquin County) D. Muller c/o Ohm & Raab, 517 E. Market Street, Stockton, Calif. for 0.25 cubic foot per second from Middle River, tributary to San Joaquin River. To be diverted in Sec. 35, T 1 N, R 5 E. M. D. M. for irrigation purposes on 20 acres in Sec. 35, T 1 N, R 5 E. Estimated cost $700.00.

Application No. 4921 (San Joaquin County) M. Bronich c/o Ohm & Raab, 517 E. Market Street, Stockton, Calif., for 2.99 cubic foot per second from Old River, tributary to San Joaquin River. To be diverted in Sec. 33, T 1 S, R 5 E. M. D. M. for irrigation purposes on 239.8 acres in Secs. 28, 29, 32 and 33, T 1 S, R 5 E. M. D. M. Estimated cost $2,000.00.

Application No. 4922 (San Joaquin County) D. Muller c/o Ohm & Raab, 517 E. Market Street, Stockton, Calif., for 2.15 cubic foot per second from San Joaquin River, tributary to Suisun Bay. To be diverted in Sec. 21, T 1 N, R 6 E. M. D. M. for irrigation purposes on 17.1 acres in Sec. 21, T 1 N, R 6 E. M. D. M. Estimated cost $2,500.00.

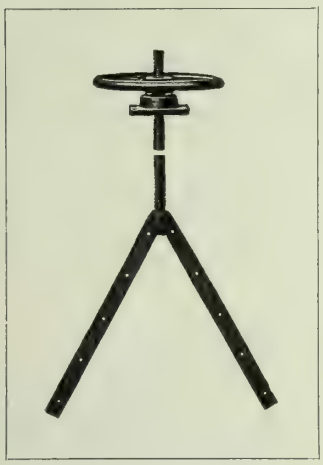
Application No. 4923 (Del Norte County) C. Romander c/o James Davis, Dist. Attorney, Crescent City, Calif., for 300 cubic foot per second from South Fk. Smith River, tributary to Smith River. To be diverted in Sec. 11, T 16 N, R 1 E. H. M. for power purposes in Sec. 10, T 16 N, R 1 E. H. M. for 3750 H. P. Estimated cost $300,000.00.

Application No. 4925 (Riverside County) Ross H. McDill c/o Frank C. Prescott, Atty., 145 S. Broadway, Los Angeles, Calif., for 1½ cubic foot per second from Cushawala Can-

·SNOW·

IRRIGATION APPLIANCES

The Snow Standard Hand Wheel Gate Raising Devices



The cut at the left illustrates the form ordinarily used with wooden canal and head gates. The screw is of steel with machine cut thread working through a bronze nut. The hand wheel, stem and screw are furnished in a variety of sizes with any desired length of thread. The Y straps may be of any length and with any desired spread. Built to fit your particular job.

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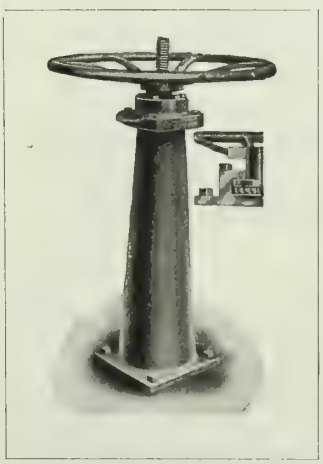

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yon, tributary to Thousand Palm Wash and Whitewater River watershed. To be diverted in Sec. 18, T 4 S, R 7 E. S. B. M. for irrigation and domestic purposes on 167.34 acres in Sec. 30, T 4 S, R 7 E. S. B. M.

Application No. 4926 (Nevada County) Jonas Hirsch, Overland Hotel, Reno, Nevada, for .37 cubic foot per second from Juniper Creek, tributary to Truckee River. To be diverted in Sec. 34, T 18 N, R 17 E. M. D. M. for irrigation and domestic purposes on 30 acres in Sec 34, T 18 N, R 17 E. M. D. M. Estimated cost $2,000.00.

Application No. 4929 (San Diego County) La Mesa, Lemon Grove and Spring Valley Irrigation Dist. Attention T. H. King, 121 S. Spring St., La Mesa, Calif., for 50 cubic foot per second and 18,000 acre feet per annum from Santa Ysabel Creek, tributary to San Dieguito River. To be diverted in Sec. 19, T 12 S, R 3 E. S. B. M. for irrigation and domestic purposes on 18,000 acres in District.

Application No. 4931 (San Bernardino County) Lead Mining Co. c/o E. H. Hughes, Mgr. P. O. Box 193, Trona, Calif., for .005 cubic foot per second from 6 unnamed springs, tributary to Thompson Canyon and Panamint Valley. To be diverted in Sec. 17, T 20 S, R 42 E. M. D. M. for mining and domestic purposes in Sec. 2, T 20 S, R 42 E. M. D. M. for mining and domestic purposes in Sec. 2, T 20 S, R 42 E. M. D. M. Estimated cost $3,000.00.

Application No. 4933 (Inyo County) American Trona Corporation, R. K. Oberteuffer, Trona, Calif., for .0198 cubic foot per second from Rattlesnake Spring, tributary to Searles Lake. To be diverted in Sec. 2, T 24 S, R 42 E. M. D. M. for mining and domestic purposes in Secs. 17, 22, 28, T 24 S, R 43 E. Estimated cost $2,000.00.

Application No. 4934 (Inyo County) American Trona Corp., R. K. Oberteuffer, Trona, Calif. for .0226 cubic foot per second from Argus Spring, tributary to Searles Lake. To be diverted in Sec. 10, T 24 S, R 42 E. M. D. M. for mining and domestic purposes in Sec. 17, 22, 28, T 25 S, R 43 E. M. D. M. Estimated cost $3,000.00.

OREGON

Among the more important applications for permit to appropriate water filed in the office of Rhea Luper, state engineer of Oregon, during February were the following:

Henry George Alois Steger of Merlin, covering the appropriation of water from a small spring for irrigation of 20 acres in Josephine County, at a cost of $300.

J. D. Agee of Grants Pass, covering the appropriation of water from an unnamed stream for irrigation of 20 acres in Josephine County, at a cost of $500.

Mrs. Adda M. DeWitt of Austin, covering the appropriation of water from Big Butte Creek for development of 25 theoretical horsepower in Grant County, at a cost of $200.

C. E. Walker and Wallace H. Edson of Tillamook, covering the appropriation of water from Munson Creek for irrigation of 35 acres in Tillamook County, at a cost of $500.

Benton Carter of Long Creek, covering the appropriation of water from Pole and Gander Creeks for irrigation of 32 acres in Grant County, at a cost of $600.

Louis C. Schafer of Central Point, covering the appropriation of water from Rogue River for irrigation of 4 acres in Jackson County, at a cost of $4,800.

J. H. Eubanks of Wamic, covering the appropriation of water from Three Mile Creek for irrigation of 5 acres in Wasco County.

W. M. Smith of Hood River, covering the appropriation of water from an unnamed spring for irrigation purposes in Hood River County.

D. L. Ebbert of Aurora, covering the appropriation of water from Molalla River for irrigation of 50 acres in Clackamas County.

First Congregational Church of Forest Grove, covering the appropriation of water from Gales Creek for irrigation of 9.276 acres in Washington County, at a cost of $1200.

George W. Bates of Portland, covering the appropriation of water from Johnson Creek for irrigation of 80 acres in Multnomah County.

T. W. Penn of Ontario, covering the appropriation of waste water from Berthold Ranch for supplemental irrigation of 50 acres in Malheur County.

Carl F. Uhden, Ernest B. Hussey, James B. Dodge, and Kenneth G. Harlan of Seattle, Washington, covering the construction of Bear Reservoir and Elbow Reservoir for storage of approximately 40,000 acre feet for irrigation and power purposes in Umatilla County. (Water to be appropriated from Walla Walla River).

R. D. Butler of Junction City, covering the appropriation of water from Amazon Slough for irrigation of 80 acres in Lane County.

Would Sell $50,000 Bonds

The Hermosa-Redondo Water Company has applied to the Railroad Commission for authority to issue and sell at no less than 95 and accrued interest, $50,000 face value of its Series B, six per cent, sinking fund, first mortgage gold bonds, due December 1, 1955; and also to issue and sell at not less than 91, $37,000 of its seven per cent cumulative preferred stock, and $26,500 of its common stock, and for a readjustment of its rates to provide a sufficient income to permit the carrying out of a construction program aggregating in excess of $100,000.

Dam Cost to Date $800,000

A report issued during February shows that the South San Joaquin and Oakdale Irrigation districts have already expended almost $800,000 on the Melones Dam, the total cost of which, with rights of way, is eventually expected to reach more than $2,000,000. Expenditures on the Melones railway aggregated $289,593.25. Of this amount $37,304.10 went for rails, $25,660.75 for ties, and $44,475.39 for equipment. Cost of the road into the dam amounted to $14,685.86. Dam and reservoir accounted for $464,878.31. This included also the rights of way. Other items are: $12,000 for diversion of water river; $83,728 for work on the foundation and $14,411.58 for concrete.

Advocates Gas for Power

(*Continued from Page 33*)

consumption will be 10 cubic feet per brake horse power hour; with 500 B.t.u. gas, 20 cubic feet, and so on until the gas content lowers to about 150 B.t.u.

A slow speed engine properly designed and properly operated will consume one gallon of oil costing from 20 to 35 cents per gallon, for each three thousand or more horse power hours of operation. Other engines may use a gallon for each 750 horse power hours.

An electric motor may be assumed to operate with an efficiency of about 90 per cent under good conditions. An engine will vary from the above stated 9,500 B.t.u. according to the load. The fuel consumption efficiency should be about 98 per cent at 87.5 per cent load; 95.7 per cent at 75 per cent load and 90 per cent at 62.5 per cent load. Of course the speed of an engine may be decreased in proportion to the load and thus retain nearly the same efficiency as at full load. This is true within reasonable limits. In fact the flexibility of an engine is one of its most desirable features.

IN THE construction of the graph (Page thirty) showing comparative costs it was assumed that an engine would be sized 10 per cent greater than the load while a motor would be the same as the load. The following rates were used:

Gas

First 200M per month per meter at	$0.55 per M
Next 300	.50
Over 500	.30

Minimum $96.00 per year.

Electric

	Rate per kwh for connected loads				
	1 hp to 4 hp	5 hp to 14 hp	15 hp to 49 hp	50 hp to 99 hp	100 hp and over
First 400 kwh per hp	3.2c	2.7c	2.5c	2.3c	2.3c
Next 600	1.8	1.5	1.4	1.3	1.2
Over 1000	1.2	1.1	1.0	0.95	0.9
Minimum per hp per yr.	$9.00	$8.00	$7.50	$7.25	$7.00

but not less than $15.00 per year.

The item of interest was omitted, and labor charges were considered to be offset.

The point of equal cost for a 25 H.P. load is 286 hours. For 50 H.P. load operating 400 hours per month the point of equal cost is 322 hours. The same load operating full time reaches equal cost at 316 hours. A 100 H.P. load operating 200 hours a month reaches equal cost at 343 hours; operating 500 hours a month, at 355 hours, and operating 730 hours a month, at 317 hours. A 200 H.P. load operating full time reaches equal cost at 301 hours. From this it may be seen that a 200 H.P. load operating full time reaches equal cost later than does a 25 H.P. load operating only 286 hours or operating full time. This is because the two rates have no relation to each other in their decrease due to increased consumption. It will also be observed that a 200 H.P. engine load will operate for comparatively little more than a 100 H.P. motor load.

Under many loads an engine will pay for itself in from two to four years. A test was made in one plant to show comparative operating costs. An engine and a motor were so placed that the same pump belt could be used from the motor or from the engine jack shaft. The test was made with motor for 24 hours and the engine for 24 hours, a few days apart. Rates were arrived at from average rates actually charged at the plant. The following results were obtained:

Electric

Average rate	1.129c per kwh
Consumption per hour inch	800.5 watts
Energy charge per hour inch	0.904c

Gas

Average rate	35.63c per M
Consumption per hour inch	9.92 cubic feet
Gas costs per hour inch	0.353c
Oil—Shell Red Extra Heavy @26c a gallon, using 3¼ gals. in 24 hrs.; oil cost per hour inch	0.023c
Labor	No extra labor required
Total engine operation:	
Gas	0.353c
Oil	0.023c
Total	0.376c

Conclusion

Total gas costs	376
Total electric costs	904
	41.5%

As stated above an engine will develop a brake H.P.H. on about 10,000 B.t.u. in the gas. With 500 B.t.u gas the cost, at 40c per thousand cubic feet would be 0.8c per H.P.H. instead of 0.4c, as obtained before. This means that in only rare cases where gas and electric rates afford considerable margin would engines be installed. With mixed gas containing 850 B.t.u. the cost per H.P.H. at the same rate would be about 0.47c, which retains sufficient margin to afford economical engine operation in a number of cases.

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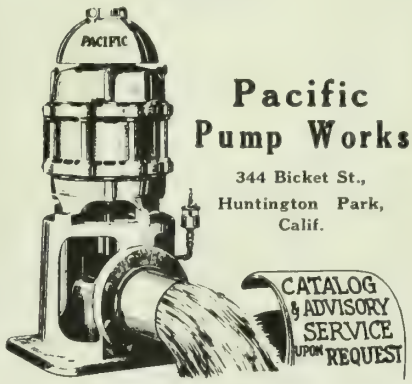

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AMONG OUR CONTRIBUTORS

Editorial Jottings About Current and Forthcoming Feature Articles, Dealing With Practical Problems of Hydraulics, and the Men Who Have Written Them

CONTRIBUTORS to this issue represent many different phases of irrigation and hydraulic endeavor, from the purely agricultural interest of the leading article, to the specialized appeals of the departmental material. The official heads of all hydraulic developments of two states are included; two of the men whose work is in this issue are known everywhere for their eminence in the institutional development of irrigation and reclamation practice; several are practicing engineers in one or another division of water work; and one article is of special interest to those who follow the legal progress of the industry.

DONALD MITCHELL, whose official connection is with the Deglet Noor Date Growers' Association, Indio, California, has written an article which will prove of consummate interest to irrigationists from many points of view. Here is a perfect example of how irrigation extends not only the amount, but the variety of food production, how it brings under cultivation new areas without increasing the competition which older farm lands must face; how it creates new crops, new demands, and a new industry, for large social and economic gains. Mr. Mitchell has been engaged in the packing and marketing of tropical and semi-tropical fruits for the whole of his professional life-time, although his identification with the date industry is comparatively recent. He is a graduate of the University of Redlands (California), served with the American air forces in France in 1917, and since his return to the United States has been engaged in the fruit industry in Southern California.

W. W. MCLAUGHLIN is known throughout the irrigation country. He is now associate chief of the Division of Agricultural Engineering of the Bureau of Public Roads of the U. S. Department of Agriculture. He would have accomplished a real service for the readers of MODERN IRRIGATION if he had done nothing more, in his article in this issue, than to show why and how the admirable organization with which he is connected has developed so long and polyliteral a name. But, of course, he does much more than that. His article is taken from the first part of an address which he made in February before the annual meeting of the Idaho Irrigation Congress at Pocatello, and is an admirable exposition of the evolution of the work of this important government institution which has kept pace with the growth in the extent and complexity of irrigation's many problems. Mr. McLaughlin is at the head of the irrigation activities of the Division, and shares the title of Chief of the Division with S. H. McCrory, who heads its drainage investigations. Mr. McLaughlin's headquarters are at Berkeley, California.

C. H. PEASE, who writes on "The Riddle of the Rio Grande," is secretary of an organization of water users in the lower Rio Grande Valley, Texas, and is also editor of the *Gravity Irrigation News*, a weekly newspaper published in McAllen, Texas, serving the people of that community and the surrounding district with special emphasis upon the underlying and basic common interest which unites them—the water supply that has made this section a productive agricultural area. In writing about the problem of the Rio Grande and the division of its water supply Mr. Pease is discussing a problem which is much more than academic. It is one that his entire section recognizes as poignantly and immediately important. Mr. Pease is at present on the Pacific Coast, spending the winter at Berkeley, California.

EDMUND K. BARNUM is chief engineer of the Fresno City Water Corporation, Fresno, California. Fresno, while not as well known as several of the coast cities of California, is one of the metropolitan centers of the west, and Mr. Barnum, by his technical work in connection with the problems of its domestic water supply, is making a real contribution to the development of water works practice on the Pacific Coast. His article gives the results of studies which he has made in the important problem of meeting the peak demand of a water supply system by an auxiliary supply. It was presented to a recent meeting of the California Section of the American Water Works Association.

WARREN G. SWENDSEN is a leader of hydraulic development in the northwest, although his experience has extended to practically every part of the continent where irrigation and drainage are largely practiced. As commissioner of reclamation of Idaho, he has become conversant with all phases of the water problems of that commonwealth, and occupies an exceptional position, from which, with incontrovertible authority, he can discuss the matters with which he deals in this article, taken from his annual address as president of the Idaho Irrigation Congress, at its meeting in February. An outline of Mr. Swendsen's professional career appeared in the February number of MODERN IRRIGATION, in which he was introduced as a member of the magazine's Board of Editorial Advisors.

M. C. HINDERLIDER is State Engineer of Colorado, which state ranks second among the American commonwealths in point of irrigated acreage. Mr. Hinderlider was educated in the middle west, gained his earlier experience in government work which took him into seven western states in charge of hydrographic surveys, has done a large amount of work in the design and construction of hydro-electric plants and irrigation works in Colorado, New Mexico and Arizona, and has been state engineer of Colorado since 1923. Among the large works with the construction of which he has been connected are the hydro power plant of the Central Colorado Power Company on the Colorado River at Glenwood Springs, hydro power pumping plants of the Orchard Mesa and Redlands Companies at Grand Junction —the largest pumping plant in Colorado—the Beaver Park masonry dam, the Terrace Dam and the dam across the Colorado near Grand Junction. He has had twenty-five years of varied experience in investigations and reports involving the study and analysis of water supplies, and the utilization of valuation of such supplies for irrigation, power and municipal uses. (See Frontispiece.)

HANKINS & HANKINS, who have prepared the article on recent decisions from western courts involving questions of irrigation law, are well known attorneys of San Francisco. They will conduct a department, in future issues of the magazine, devoted to this important subject.

N. C. GROVER is chief hydraulic engineer of the United States Geological Survey, and his paper represents an interesting analysis of the part played by this useful government institution, which is constructively contributing to the development of hydraulics.

F. M. BANKS is supervisor of sales for the Southern Counties Gas Company, at Los Angeles. His article on the costs of gas is an abbreviated presentation of a lecture, prepared not for the consumer of gas, but for the vendors of gas engines and of the fuel. Only that part of his remarks which seemed to contain information usefully applicable to the pumper of irrigation water was selected for inclusion in this article, but even in this excerption the reader will notice that the author is speaking primarily to his own industry rather than to the irrigation reader. His analysis of the costs of gas and his comparison of gas with other fuels is nevertheless of real interest to irrigators, especially in Southern California, where the gas engine is extensively used.

JOHN A. WIDTSOE is one of the "big" men of reclamation. His article on the five essentials of a successful policy of colonization is interesting not alone for its compressed wisdom, but for the fact that it approaches the problem from a standpoint very different from the ordinary. Dr. Widtsoe is eminent in the Mormon church, and he naturally refers to the experience of the Mormon pioneers of irrigation for much of the illustrative matter of his article. On account of this concern, also, he emphasizes the part that the spiritual and religious elements of settlement play in successful reclamation. As chairman of the northern board of survey and adjustments he has had ample opportunity to contact with the successes, the failures, and the near failures of settlement attempts, and he speaks from the standpoint of many years devoted to the study and practice of reclamation.

J. O. QUILLER and HUGH CRANE are staff contributors. ORA MCDERMITH is consulting engineer of the Kittitas Reclamation District, Washington. For his article acknowledgements are due to the *New Reclamation Era*. R. P. LEHR is connected with the Killefer Manufacturing Company, Los Angeles, and has contributed articles on overhead irrigation to previous issues.

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For 12 Months: $2.00; Single Copies: 20 cents.

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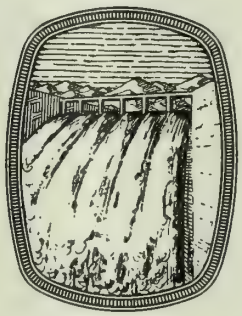
HON. C. C. MOORE

Governor of the State of Idaho, who, during March, led a delegation of influential business men on a trade mission to Southern California in the interest of closer commercial relations between the northwest and the southwest. Governor Moore is an ardent supporter of irrigation, and, during his California sojourn, took occasion to testify to his great confidence in the future prosperity of the whole Western United States under a program of expanding irrigation.

MODERN Irrigation
The Magazine of Applied Hydraulics



Volume II APRIL, 1926 Number 4

The Progress *of* Irrigation

FLOOD CONTROL work in Southern California suffered severe damages in the early April flood resulting from torrential rain storms that were general over the south Pacific Coast area, sweeping in from the sea and proceeding eastward over Utah and Nevada. At Pacoima, where Los Angeles County is constructing a flood control dam which will be the highest structure of the kind in the world, with a height of 375 feet above streambed, the construction works of Bent Brothers, who are the contractors on the job, were covered with debris, and the excavation, which was progressing rapidly toward completion, was refilled twenty-five feet with rock and gravel. The work on this dam will be delayed a month as the result of the damage sustained.

The Puddingstone dam, another flood-control structure, near San Dimas, California, gave way under the accumulation of water and released more than 300 acre-feet of water, doing considerable damage to homes and orchards below. This construction was of a temporary nature, only a portion of the concrete foundation for the dam having been completed. Ultimately it is to be an earth dam, and 100 feet of its foundation was undermined and washed out in the storm.

The damage sustained in Southern California and elsewhere, however, was for the most part forgotten in the general rejoicing over the much-needed and very generous rainfall, which exceeded recorded storms for April at many points, and dissipated the fear which remained, after a rainless March, that a "dry year" might still menace the water supply of the coming summer.

At Los Angeles, the seasonal rainfall was brought to a point slightly in excess of the normal seasonal total of 14.23 inches. At Riverside, April storms gave a season total of more than twice the total rainfall of 1925. As MODERN IRRIGATION went to press, more storms were predicted by the U. S. Weather Bureau, and prospects for a year of abundant water were hailed with jubilation throughout the state.

AN INTERESTING side-light on the rainfall situation is the fact that a "weather prophet" who has attained a large measure of publicity from his accurate—or fortunate—predictions in the past, released a prognostication at the

close of March in which he announced, in phrases as unqualified as are ever employed in such forecasts, that April would be a rainless month in California. The fact that the first week in April brought more precipitation than has ever before been recorded for the entire month provides food for thought for those who are inclined to give undue credence to such prophecies.

Speaking of the claims to accuracy in weather predictions of exponents of "sun-spot theories" and similar systems of forecastings, in a recent conversation with the writer, Dr. Robert Millikan, probably as great a physical scientist as the world now possesses, disposed of their claims in a brief but pithy observation, when he said: "The weather, as we all know, is a relatively local matter. Sun spots are not a local matter. It is difficult to see, therefore, how they can be interpendent."

GOVERNOR C. C. MOORE, of Idaho, who led a trade mission of state officials and business men to Southern California during March, recognizes the problems of water supply, irrigation and hydraulic developments as among the fundamentals of statesmanship. In an interview with a representative of MODERN IRRIGATION, Governor Moore gave an interesting statement with reference to the hydraulic problems which are now facing the west.

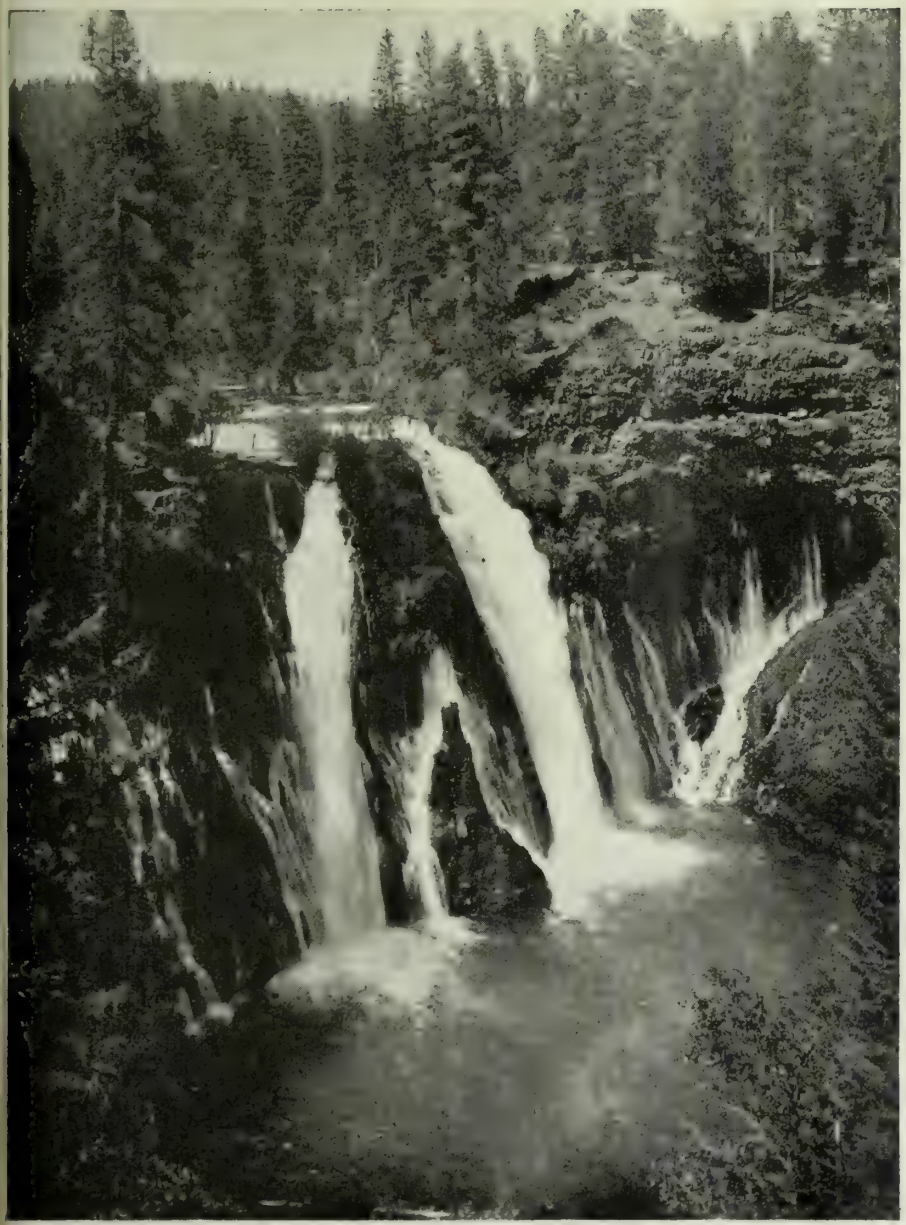
"The question of widest interest," said the Governor, "is the question of the development of the Colorado River. The problem of the Boulder Canyon project involves an enormous contemplated expenditure in the interest of making available a large and much-needed potential resource of the whole nation. While I am opposed to the government engaging in the power business, and believe that this, like other business activities, should be left to the ingenuity of private endeavor, nevertheless, because of the complications of interstate nature that exist in the Colorado River situation, the enormous investment which the proposed plan would require, and the national importance which its development may assume, the Boulder Canyon project may quite properly be a problem for the national government. But I should doubt the wisdom of its development under any plan which would put the government permanently in the commercial power business. I believe the states affected should have the right to develop this resource in their own interests, as and when they desire.

"Idaho has a quite similar problem in dealing with her sister states in the allocation of the waters of the Columbia River. This is being urged by the state of Washington in the interest of the early development of the Columbia Basin project. Idaho is addressing itself diligently to the task of gathering data on this stream with a view to outlining a position which will, first, adequately protect her own interests, and second, serve the needs of her neighboring states. This study is being conducted under the direction of Idaho's state department of reclamation. Until the data are gathered and compiled, no definite statement can be made of the position of our state."

"IDAHO, herself, is making a notable record in the matter of utilizing her water resources," added the Governor. "During the last 26 years some very ambitious projects have been constructed, until now the state contains an irrigated area of more than 3,000,000 acres.

"Favorable natural conditions, careful planning, engineering skill, and permanent materials have been employed in the building of these projects. The water supply is abundant and its delivery to meet all crop needs is always assured. The natural flow of streams providing water for this area is regulated in more than one hundred storage reservoirs of comparatively large size, having an aggregate storage capacity of 5,400,000 acre-feet. This capacity does not include the American Falls Reservoir of 1,700,000 acre-feet now under construction. Farmers are not always required to apply water concurrently with its appearance in natural flow. Stored water is available when the crops require moisture. Full production is, therefore, always assured.

"About two million acres of the State's irrigated area is embraced in municipal irrigation districts. In pioneering this development, the State, like most of the arid West, made errors in its original financial setup and, unfortunately, some investors did not secure the returns to which they were entitled and rightfully expected. The present policy of the State is to carefully guard its credit by preventing the offering of unsound securities, thus lending stability and positive value to its irrigation district bonds. This policy has so far restored confidence that in recent sales of such securities money has been obtained on a 5¾ interest basis in addition to a substantial bond premium."



Beautiful, as well as valuable—this photograph shows Burney Falls, on Burney Creek, Shasta County, California; one of the streams covering which adjudication proceedings have been conducted by the California Division of Water Rights.

WHOSE WATER ?

How California Deals With the Troublesome Water Rights Question

By GORDON ZANDER

Associate Hydraulic Engineer, California Division of Water Rights, Department of Public Works.

GROWTH and progress in any western state in the future will be largely dependent upon an orderly, systematic and judicious development of its water resources, and in order that such development may proceed, and that the necessary capital may be attracted, titles to the use of water must be established and made secure. In California, the recognition of this fact is manifest in the attention given to the adjudication of water rights.

Since December 19, 1914, the date on which California's Water Commission Act went into effect, water rights by appropriation in that state can be initiated only by application to the Division of Water Rights (or to the State Water Commission, its predecessor), in which cases state supervision is exercised over the acquisition of the rights.

If permits are issued, followed by construction and application of the water to beneficial use with due diligence, the rights become established and of record as to priority and amount of water appropriated.

Prior to the enactment of the Water Commission Act, however, no definite or specific control was exercised over the acquisition of water rights by appropriation, nor was it even compulsory that they be recorded. No limit was placed upon the amount of water that could be claimed, and it was the custom to file upon much more water than it was expected to utilize. In many cases the filings were not followed by construction and use, and consequently no rights became vested; on the other hand there are many valid appropriative rights in existence which are based upon use alone, and of which there is no record.

As a result of the conditions prevailing prior to the enactment of the Water Commission Act, all appropriative rights initiated prior to December 19, 1914, are undetermined as to amount of water appropriated and many are undetermined as to priority except on the comparatively few stream systems in the state where the water rights have been adjudicated. In addition to the undetermined appropriative rights, there are the many water rights claimed by virtue of riparian ownership, prescription or adverse use, of which there is no record.

In order that all existing water rights may be determined and placed of record, to the end that they may be made the basis for distribution of water, under the supervision of water masters whenever it becomes necessary that such control be exercised, and that they be known so that they will not be infringed upon by new rights which may be acquired, the Water Commission Act has, in Section 24 and in Sections 25 to 36f, inclusive, provided for the adjudication of water rights.

SECTION 24 of this Act provides that any suit involving the determination of water rights which is pending in the Superior Court may, in the discretion of the court, be transferred to the Division of Water Rights as referee.

Under this procedure all water rights of whatsoever character may be included, and the proceedings may be initiated by the filing of a friendly suit by one or more claimants against all other claimants from the stream system, following which the transfer of the case to the Division of Water Rights will doubtless be granted if petitioned for by the parties.

Upon receipt of an order of reference, the Division proceeds to ascertain the physical facts through an investigation in the field, which ordinarily includes measurements of the water supply and of the various diversions, surveys of the various irrigated areas, and a study of the various factors upon which the duty of water is based. If it is impossible to get all of the claimants to agree upon an allocation of the water supply after the physical facts are known, a hearing is held by the Division, at which the necessary testimony is heard upon which to base findings as to priorities and any legal points that may be involved. A court reference is terminated by a report from the Division to the court, which includes findings of fact, conclusions of law, and a proposed judgment and decree.

The report is, of course, subject to modification or rejection by the superior court, and after a hearing upon any objections thereto has been held by the court, a decree is entered establishing the water rights involved. The court reference procedure is the only method by which riparian and prescriptive rights may be brought before the Division of Water Rights for determination; consequently it is the procedure that should be followed on all stream systems where such rights are involved to any considerable extent.

Section 25 of the Act provides for the initiation, either by the Division of Water Rights on its own motion or by a petition signed by one or more claimants from the source involved, of proceedings for the determination of all water rights by appropriation upon any stream system. In the case of proceedings thus initiated, the procedure outlined in Sections 25 to 36f of the Act must be followed, and only water rights by appropriation may be included. The procedure is similar to that followed under court reference, except that upon completion of the field investigation each claimant is required to submit proof of his claim in the form of an affidavit; any claimant is allowed to contest the proof of any claim, and hearings are held on all contested claims. The proceedings are terminated by the filing of findings by the Division in the superior court, which findings may be confirmed or modified by the court after a hearing on any objections raised.

BY THE procedure provided in the act, adjudication proceedings may be initiated in advance of actual conflict between water users, and injury to vested rights due to diversions by junior upstream users may be averted. Trouble may thus be anticipated and forestalled, the continuance of amicable and neighborly relationships promoted, and strife and litigation reduced to a minimum. All water rights on a stream system may be determined in a single proceeding, which rights might otherwise form the basis for numerous individual suits. The physical facts are determined by specially trained engineers, who are state employees and disinterested parties, and as a result the conflicting evidence as to physical facts with which a court is usually confronted in water right cases is largely eliminated.

The length of time consumed by adjudication proceedings will vary from one to three years, depending upon the extent of the water rights involved, and the number and nature of the contests that may develop. A time record was recently made in two proceedings in Modoc County, one involving the water rights on Owl Creek and the other involving those on Soldier Creek. These two cases were transferred to the Division by court orders dated April 28th, 1925, and May 21st, 1925, respectively; the field investigations were conducted simultaneously covering the major portion of the 1925 irrigation season; the maps and engineering reports were completed in December, 1925; and the reports of the Division, as referee, were forwarded to the court on March 8th, 1926. It is expected that decrees will be entered in the two cases in time to be enforced during the 1926 irrigation season.

The cost of adjudication proceedings depends upon the total area irrigated from the stream, the sizes of the various tracts of land irrigated, the topography of the area which must be surveyed, the number of diversions, the accessibility of diversions, the quantity of existing hydrographic data, the number and nature of the contests that may develop, and the distance of the stream from Sacramento. On the adjudication proceedings already completed by the Division, the cost per acre of irrigated land has varied from thirty-five cents to sixty-seven cents. Present indications are, however, that cost of several pending proceedings which involve relatively small irrigated areas will run as high as a dollar per acre.

Automatic water stage recorder established on Soldier Creek, Modoc County, California, by means of which a continuous record of its flow was obtained throughout the 1925 irrigation season.

TO DATE the Division of Water Rights and its predecessor, the State Water Commission, have undertaken fifteen adjudication proceedings, of which ten have been initiated by court reference and five under the provisions of Section 25 of the Act. Of the proceedings undertaken, seven have been successfully terminated by court decrees, one failed of completion because of involved land ownerships and other pending litigation, and seven are still pending.

The completed adjudications have resulted in the establishment of all water rights on the following stream systems:

Willow Creek in Lassen County, from which about 1000 acres are irrigated.

San Pedro Creek in San Mateo County, from which about 500 acres are irrigated.

North Fork of Cottonwood Creek

(*Continued on Page 25*)

Irrigation Districts Association Holds Annual Meeting

Adopts Important Resolutions, Hears Valuable Discussions and Addresses, Views Exchequer Dam

By HUGH CRANE

MEETING at Merced, California, during March, the Irrigation Districts Association of California, representing the greater part of the district organizations of the state, went on record by resolution with reference to several questions of vital importance to irrigation. The Association—

Endorsed the proposed Boulder Dam development on the Colorado River.

Opposed the unnecessary destruction of brush and forest cover on the upper watersheds of western streams, and urged the government to inaugurate a stricter policy of conservation.

Condemned proposed state legislation providing for a tax on the gross revenue of publicly owned utilities.

Urged that a nationwide campaign be instituted by the Bureau of Reclamation, to present the "sunny side" of the accomplishments of reclamation during the past 23 years.

Declined to endorse the policy of statewide water development advocated by the California Farm Bureau Federation, preferring to withhold action until the current survey of the state's resources has been completed.

THE MARCH meeting was made doubly valuable to the Association by the circumstances under which it was held. The members met as the guests of the Merced Irrigation District, and after business sessions at which practical addresses and discussions were featured, more than one hundred of them enjoyed a tour of inspection of the Exchequer Dam, now nearing completion.

William Durbrow, president of the Association, was in the chair when the meeting convened, and after a brief historical summary of the work of the organization, introduced C. E. Kocher, president of the Merced Irrigation District, who welcomed the guests.

Matters of irrigation law, litigation and legislation held the center of interest during the opening session. A. E. Chandler, under whose direction briefs were filed on behalf of the Association in the Herminghaus Case, reported on the status of this important matter. Briefs were filed for the Association by its attorneys as *amici curiae,* opposing the contentions of both litigants. A letter of thanks was received from the Nevada Irrigation District, for the assistance rendered by the Association in its recent case before the Federal Power Commission. W. D. Wagner, secretary of the Association, reported on the California legislative situation, pointing out that although the organization expected to have only six measures before the last session of the California legislature, some sixty bills made their appearance, but few of the bills which lacked the support of the Association became laws.

Paul Bailey, deputy chief of the California Division of Engineering, reported on the progress of the investigations, undertaken by his Division, of the water resources of the state; and Edward Hyatt, Jr., Chief of the Division of Water Rights, spoke on some of the problems of the Division.

Other speakers at the first day's session were R. V. Meikle, chief engineer of the Merced Irrigation District, who discussed some aspects of the Exchequer Dam construction; W. S. Rosecrans, vice-president of the state Farm Bureau Federation, who presented the policy of his organization with reference to state water developments; C. L. Childers, attorney for the Imperial Irrigation District, who spoke on the Colorado River problem and Boulder Canyon project; George L. Swendsen, chief engineer and general manager of the Fresno Irrigation District, who discussed "Irrigation District Management," and John Dwight Neale, of the J. R. Mason & Company, who spoke on "Irrigation District Bonds."

AMONG the topics arising for discussion were several of general interest. A letter from the Stinson Irrigation District came before the Association in which the question of a district's responsibility for the delivery of water upon the land of the user was raised. Officials of the Stinson district declared that they had heard that, in a recent decision against the Turlock district, it was held that it is incumbent on a district so to construct its system of ditches that the district can deliver water to the land of the user.

Discussion revealed, however, that in the case of Bushman vs. Turlock District, the decision was the reverse of the understanding of the Stinson district.

Comparative merits of district-owned and maintained laterals as against privately maintained ditches were urged pro and con in a long discussion centering on the question of lateral ditches and their management.

WILLIAM DURBROW
President, Irrigation Districts Association of California

The incomes of irrigation district officials and employees are exempt from income tax, so far as they are derived from the district, it was announced by the secretary, in response to inquiries from several districts. Incomes from the political subdivisions of states are exempt from the operation of the federal income tax, and irrigation districts are specifically included in this class of exempt organizations by the Revenue Act of 1926, as are Drainage and Reclamation districts as well.

RESOLUTIONS adopted by the Association included the following endorsement of the Boulder Dam and All-American Canal, introduced by Mr. Childers, of the Imperial Irrigation District:

Resolved, that the Irrigation Districts Association of California, assembled at Merced on the 11th day of March 1926, and representing approximately four million acres of irrigable land in California, regards the early construction of the Boulder Dam and All-American Canal as a unit of primary importance to the irrigation interests of California in general, and to the safety of Imperial Valley in particular, and urges upon the representatives in Congress from California to use every effort to pass the Swing-Johnson Bill, thereby authorizing this development at the present session of Congress.

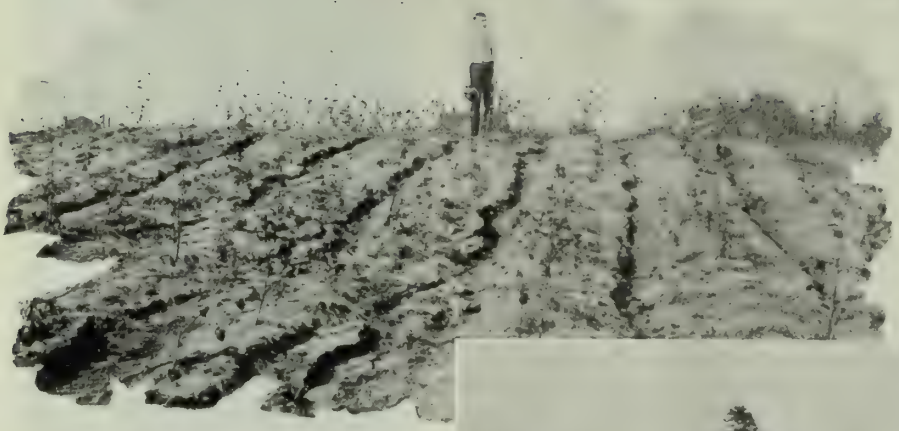
And be it further resolved, that a copy of this resolution be handed to each member of Congress from California and a copy spread upon the minutes of this meeting.

Mr. Childers also brought up the pending case of Crawford vs. Imperial

(*Continued on Page 29*)

How Drainage Pays the Farmer

There is No Investment That Returns Better Dividends to the Farmer Than Good Drainage



Land that is well drained, compared with land that wasn't. ABOVE: *the type of erosion that occurs in many fields, unterraced, where clean cultivated crops are grown.* BELOW: *Land prepared with the typical broad-base graded terrace.*

By S. H. McCRORY*

Chief of the Division of Agricultural Engineering, Bureau of Public Roads, U. S. Department of Agriculture

THAT A well drained soil is the foundation of successful agriculture is an accepted fact. Many of our fields are naturally well drained but there are also large areas that need artificial drainage if they are regularly to produce the best yields of which they are capable. There is scarcely a farm in the country on which there is not some land which would be benefited by better drainage. In places the individual farmer can by his own efforts provide good drainage for his lands. In other places a few farmers must organize under the state drainage laws if their farms are to be drained while in other localities it may be necessary for very large groups of land owners and other interests to combine if adequate drainage or flood protection is to be secured. In the last 35 years great progress has been made in the drainage of our wet lands. Millions of acres have been supplied with outlet drains and made available to the farmer. Truly a great work has been accomplished.

Much has been accomplished but more remains to be done. Outlet drains have been supplied through large areas. Farm drainage unfortunately has not kept pace with the construction of outlet drains. The best information available indicates that there are in the United States today about 200,000,000 acres of lands that would be benefited by better drainage. In recent years the American farmer has had a difficult situation to contend with and in many instances it has cost him more to grow crops than they could be sold for.

I believe that many farmers by improving the drainage of their farms could materially increase their income. Let us consider for a moment what drainage does for the soil and plants that grow from it. A supply of air, water and plant food are necessary for proper plant growth. Drainage removes excess water from the soil, air enters the pores from which the water has been removed and plant roots can penetrate into the soil.

The roots of most plants will not penetrate below the levels of the free water in the soil. If, in the spring, the water table is only a few inches below the surface the roots will penetrate only that deep. When a dry spell comes the roots soon exhaust the moisture in the soil and plant growth is stunted or entirely stopped. Had the soil been well drained the roots would have penetrated deeply in the soil and when the dry spell came would have had a much larger amount of soil from which to draw water and plant food. With some crops it is important that the water table be held at the uniform level. If it fluctuates slowly it kills the plant roots as it rises and when it falls the roots are diseased and do not follow the moisture downward so readily as they first did. Some investigations that we have made recently in Florida indicate that this problem is of considerable importance in the citrus groves; studies in the West indicate that the same condition holds true for the orchards and for alfalfa.

The ideal form of farm drainage is undoubtedly tile but with the present price of tile and labor many farmers feel that they cannot afford to undertake such expensive improvements. Recently, I have been giving considerable study to farm drainage problems and I

*Delivered before the Fourteenth Annual Meeting of the National Drainage Congress, Oklahoma City, Okla.

wish to submit to you for your consideration some ideas on this subject.

ON MANY farms throughout the United States considerable benefit could be obtained if the farmer would construct surface ditches that would remove or prevent water from ponding on low places on his farm. These drains he could construct during the intervals between farm operations when he has a few spare days. The ditches could be built either with a shovel, with a plow and road scraper, or with a ditcher.

If the farmer plans to undertake such improvements he should observe closely conditions on his wet lands during heavy rain storms and notice how the water flows and where it stands and where the lowest places are in the ridges which hold the water on the land. It would be well to mark these places with stakes so that he can locate them later. He should then, at the first time that crops on the land will permit, build his ditches, endeavoring to keep a uniform grade so that the water will flow out readily.

When the first rain storm occurs after he has built the ditches he should observe how the water flows through them and if there are any high places they should be marked and after the water has had a chance to run off and the soil dry out these places should be removed. Many a farmer would profit greatly if he were to spend some of his time for the next year in building such ditches. Improvements of this character call for no expenditure of money and only the use of his own time and equipment.

When the farmer feels that he can afford to make some expenditure to improve his farm, tile drainage is one improvement that should have careful consideration. Personally, I believe that there is no better investment than a well planned and carefully laid tile drain. If, as is the case with most of our farmers now, there is a limit to the amount that he can spend, I would locate the drains so as to drain that portion of the field which had the greatest need for drainage. By carefully fitting the drains to the field much can be accomplished with a few strings of tile. If later more drains are found advisable they can be added. In many fields, however, a few random lines of tile are all that are necessary.

HAND IN HAND with drainage should go the prevention of erosion. If the fertility of our fields is to be maintained this is essential. It is more than this, in many localities as streams are filling up and losing their value as drainage channels. This is true in Oklahoma, in Iowa, in North Carolina.

Recently, we have been conducting some experiments in co-operation with the North Carolina Agricultural College and the North Carolina Department of Agriculture to ascertain if we could determine some of the fundamental principles which control the designing of terraces for preventing erosion or washing of the soil from cultivated fields. During the course of these experiments we have been catching and weighing the soil washed from a series of plots.

During one six weeks' period in the summer of 1924 rather heavy rains occurred and the soil was washed from two of the plots at the rate of a pound per square foot or more than 21 tons per acre. Stated another way, a sheet of the soil about one hundredth of an inch thick was washed away.

Land on which this occurred was not a steep slope, but is gently rolling. Many good farmers would say that such a soil on such a slope would not need terraces to prevent erosion. The University of Missouri in a series of similar experiments which they have reported recently secured quite similar results. There is perhaps no more important problem confronting our country today than the conservation of its arable lands. The best method that we now have is the broad-base variable grade terrace. With very little assistance any farmer can construct it with his own teams and equipment and no expenditure of funds. Properly constructed it should practically stop the washing of his fields and permit him to obtain full benefit from the fertilizers that he applies. Terraces will also stop the sand and silt that has in the past been washed down into our main drainage channels and prevent their becoming obstructed.

The trenching machine at work. These machines are taking much of the drudgery out of large-scale drainage operations where they are employed

Mr. McCrory Says:

In too many places we have stopped with the construction of outlet drains and have not encouraged the farmer to complete the farm drainage on which his prosperity depends.

It has been said that the last ten per cent spent on the completion of a drainage system brings ninety per cent of the profits. When this ten per cent is spent in improving the drainage conditions of the farm so that full use can be made of the outlet drains, this is frequently the truth.

The drainage that pays is the drainage that permits the farmer to increase his yields and to secure the maximum return from his lands.

There are in the United States today about 200,000,000 acres that would be benefited by better drainage.

ONE DIFFICULTY or defect in our drainage work in the past has been that in many places we have stopped with the construction of the outlet drains, and have not encouraged the farmer to complete the farm drainage on which his prosperity depends.

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During these periods of depression when the farmer does not feel that he can afford to make heavy outlays of capital for improvements, I believe that we should bring to his attention

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Pipe Corrosion—Its *Causes*, and a *Preventive Method*

Waterproof Coverings are Saving Money for Many Western Irrigation Districts

By DOZIER FINLEY

IT HAS long been the custom to design certain steel constructions with such an excess of metal that the structure will be serviceable even after a considerable portion has been destroyed by rust. This appears to be especially true of steel pipe of nearly all weights and sizes. Everywhere we may find pipe sufficiently thick to withstand a pressure of 500 pounds per square inch and yet the working pressure may not be above thirty pounds. It is seldom that pipe fails by water hammer or by the stresses set up by expansion and contraction until after it has been greatly reduced by corrosion. Furthermore pipe usually develops leaks long before it fails through excessive mechanical stresses. This is due to the ugly habit of "pitting," by which "pits" may be formed extending entirely through the pipe wall although other portions of the pipe may be as perfect as on the day it was manufactured.

It is estimated that corrosion destroys steel pipe in the United States to the value of over $20,000,000 per year. Probably over $30,000,000 is spent each year for excess metal in pipe walls so that a longer time will be required for pitting to render the pipe valueless.

This 44-inch water line, near Niles, California, was protected with a mechanically applied felt base bituminous covering.

STEEL IS CHEAP and may be had in almost unlimited quantities. If it rusts away the user builds succeeding structures heavier in weight, seeking to protect the easily corroded metal with extra thicknesses of the same metal. It is a policy not dissimilar to that of the housewife who exclaimed, "Oh, the moths destroy garments so quickly—we shall have to buy much heavier clothes!"

Fortunately the irrigation engineer cannot be charged with a wasteful use of metal in his pipe construction. The generally low pressures employed, the competition with open ditch construction, flumes and concrete pipe, and the limited amount of money usually available have brought about the practice of using pipe only sufficiently heavy to withstand all mechanical stresses save that due to diminished internal pressure.

But corrosion of underground steel irrigation pipe will proceed as rapidly as corrosion on heavier pipe used in other services, except that irrigation pipe is seldom subjected to actual electrolysis. Having thinner walls, irrigation pipe may be expected to become unserviceable in far shorter time than standard lap welded steel pipe. But the irrigation engineer meets this situation by seeking to use the most effective methods of protection against corrosion.

It has been a custom for years to dip pipe of this character in molten asphalt. The coating thus produced ranges from about ten to seventy thousandths of an inch thick, according to the duration of the dip, the temperature and other factors. On the inside of the pipe such a protective coating is no doubt effective, but on the exterior its value is questionable, because handling before the pipe is laid and covered will bring about so much abrasion that corrosion and pitting find ample opportunity to begin their activities even before the pipe is put in service. Tests have shown the most careful inspection will not detect the presence of a large percentage of such abrasion.

DOZIER FINLEY

Mr. Finley is director of technical research for the Paraffine Companies, Inc. His article discusses some of the problems of protection for underground pipe in irrigation and water works use.

PAINTING of underground pipe is apparently of little value unless soil conditions are very favorable—and in our Western states soil conditions are usually unfavorable. Dipping in tar pitch is not practiced in the west because tar pitch is produced only in extremely small quantities on the Pacific Coast. Galvanizing is generally regarded as a protection against corrosion, but in bad soils the galvanized coating itself becomes subject to attack. Encasing the pipe in concrete usually does not take account of expansion and contraction, which can only be equalized between the concrete and the steel by using an excessive quantity of concrete.

Probably the greater part of the discussion on corrosion of irrigation pipe should be addressed to the western states for two reasons; (1) corrosion of pipe is uniformily more severe in the west than in the east and (2) irrigation is practiced almost solely in the west. It is difficult to say just why this corrosion is more severe in the west. It can hardly be attributed to the soil, because similar soils occur in both the east and west. It cannot be attributed to the alternate wet and dry seasons of the west because pipe in certain limited sections of the Mississippi valley, where summer rains keep the ground continually wetted, will be destroyed as quickly as pipe in the worst sections of the west.

The Bureau of Standards at Washington is conducting tests on pipe buried

in different soils in over forty locations in the United States. When these tests are completed several years hence, we may know more nearly why one soil is corrosive toward pipe and another is not. At present we cannot accurately predict the corrosive action of a soil—we can only judge of its action by examining steel specimens which have been buried in it.

IT APPEARS strange we do not know exactly why steel corrodes. Many factors and agents appear to combine to produce the rusting action, but we do not know just what takes place as particle after particle is torn away from the parent metal and converted into the material known as "rust." When the action has been followed as far as scientific observation will take us, there remains a gap—that gap we try to bridge with theories.

All the collected facts and all the theories pieced together, agree on one thing (which indeed is a matter of common everyday observation): iron or steel will not rust if kept perfectly dry. We are led to believe, then, that either water itself is the agent engaged in the corrosion or that the water, through its solvent action, carries to the metal dissolved foreign matters which bring about the attack. It has been demonstrated that pure water, free from air and other dissolved gases, exerts only the most minute rusting action on iron. But this action is increased many fold if air, or certain salts, even though neutral (i. e. neither acid nor alkaline) are dissolved in the water. Water, therefore, appears to be at least one of the factors or agents which has the widest influence on whether or not corrosion shall take place.

There are, it is true, other factors. The writer has found the texture of soil may cause corrosion to appear at certain portions of a pipe line, while other portions are unaffected. Where the soil is wet or dense or the pipe buried deeply, while adjacent portions of the pipe are in loose or dry soil, or are near the surface, there is very frequently corrosion, and the corrosion appears on those sections, strange as it may seem, which have been cut off from the air by extreme density or wetness of the soil or by deep burial. Yet it is not the access of air that prevents corrosion—it is merely that on some sections air reaches the pipe more freely than on nearby sections—in other words it is the difference in the conditions which brings about the corrosion. By electrical measurements this difference of soil conditions around adjacent pipe sections has been demonstrated to set up electrical currents in the pipe; in other words to make an electrical battery out of pipe and soil. Where there is a battery of this type some of the metal must be destroyed—in this case the only metal is the steel of the pipe and consequently a portion of that is destroyed. This condition cannot be combatted by burying the pipe at a constant depth in soil of uniform texture and wetness because these factors themselves cannot be controlled. But there are other factors which cause corrosion—a piece of pipe so small that it is all buried in soil of uniform texture and wetness, a piece of one inch pipe one inch long, we will say, often will corrode just as actively as a ten inch pipe line a mile long!

BUT, as we have said, water appears to be at the root of this evil in some way. If the metal of the pipe can be kept dry the corrosion should not take place. Dipping of the pipe apparently affords a very good interior protection and dipped pipe can be laid without serious injury to the interior dipped coating. The interior of the pipe is exposed only to the flow of water and therefore the metal, if any happens to be unprotected, is subjected to a condition of extreme uniformity; this usually is favorable to a low rate of corrosion.

Recognizing the fact that the average dipped coating is not wholly dependable as an exterior protection, efforts were made as early as 1905 to wrap bituminous saturated and coated felts around pipe by hand. At first the wrappings were not tightly applied and water found its way between the pipe and the covering. In about 1916 mechanical application of the covering was tried. By means of heavy machines, which drew up the highly waterproof covering tightly against the pipe and cemented it thereto by a heavy asphaltic cement, 250 miles of pipe were covered for the Lindsay-Strathmore and Terra Bella Irrigation Districts. This pipe was all of 16 gauge, some of it being as large as 36 inches in diameter, and was asphalt dipped before being wrapped. When examined by the writer in 1925 this pipe was in practically perfect condition—in fact there was no record of any leakage which had come from corrosion starting on the exterior of the pipe.

Since 1916, thousands of miles of irrigation, gas, water and oil lines, ranging from ¾-inch to over 60 inches in diameter have been covered by mechanical application of bituminous covering materials made by the company with which the writer is associated. Applying these coverings has been done either in the shops where the pipe was fabricated, as in the case of irrigation and waterworks pipe, or by means of the Pabco Portable Wrapping Machines used in the field or pipe storage yards in the case of oil and gas pipe. Mechanical application of waterproof covering to pipe for underground service is rapidly becoming standard practice—it is so much less costly and more effective than "protecting steel with steel" that it is now the policy with some companies to cover all pipe, regardless of slight differences in soil conditions; corrosion is so uncertain in the location and intensity of its attacks that it doesn't pay to "take a chance." It has since been proved that had the Lindsay-Strathmore and Terra Bella Irrigation Districts "taken a chance" and installed unprotected steel pipe of similar weight in place of the covered pipe, replacement and maintenance down to the present date would have reached a figure probably exceeding the original cost of the system.

Wrapping 10-inch pipe in the field with two layers of felt base protective bituminous covering, and an outer layer of non-adhesive paper, using portable pipe wrapping machine. Mr. Finley tells how these machines save money.

Two Rivers of Doubt

Shall Conflicts of Interest on the Colorado and the Rio Grande be Settled Jointly or Individually?

By C. H. PEASE

Secretary, Lower Rio Grande Water Users Association

PART TWO

OVER two of the Southwest's great rivers, destined to loom large in the future development of irrigation, there hangs a shadow of uncertainty. One—the Rio Grande—for a large part of its course forms the international boundary line between Mexico and Texas, and empties into the Gulf of Mexico. The other—the Colorado River—originates high in the Rockies, flows through most of the lower western states, and after a short, but important, journey through Mexican territory, enters the Gulf of California.

The destinies of both streams are shadowed by a cloud of doubt. There are analogies between them, and there are interesting contrasts. But—most significant—there is a definite relationship of the one to the other, which makes the settlement of the problems of the Colorado a matter of vital interest to the water users who derive their supply from the Rio Grande.

In the first installment of this article, the situation along the Rio Grande was briefly sketched, with a view to showing that some kind of an international agreement, looking toward the creation of storage reservoirs on that river, is urgently demanded by the present status of American lands and the impending development of lands on the Mexican side.

For obvious reasons, Mexico has not as yet evidenced any concern over the constantly increasing appropriations of water that have been made on the American side. She has but a relatively insignificant development in the Delta region. There are a few small plantations located on the immediate bank of the river which produce principally cotton. Small pumping plants supply water for the irrigation of these lands, which comprise but a few thousand acres, all told. So far, there has been little difficulty experienced in getting sufficient water for all demands on both sides of the river. There have been no controversies over this water supply and no protests from Mexico.

That Mexico has not exploited her own lands is doubtless due to the unsettled political and industrial conditions that have prevailed in that country during the period in which the American side has made its rapid advance. In fact, during the early period of American development, a rather ambitious undertaking was launched on the Mexican side that rivaled in size the very largest of the projects on the north side. Several miles of main canal were completed and pumping machinery had been assembled, when the appearance of the army of Pancho Villa, the bandit, brought an abrupt termination to the enterprise. It has never been resumed.

In the meantime, appropriations on the American side have reached the point where the entire normal flow is required to meet the demands of the lands already brought under the several projects. If these diversions were so situated that Mexico could be deprived of access to the water she would doubtless have viewed with more concern these gradual encroachments. However, it is physically impossible to deprive Mexico of the ability to help herself to this water. By the simple expedient of locating her own pumping plants on the south bank, Mexico will have an equal chance to supply her needs.

In fact, Mexican engineers are in possession of complete data covering a proposed canal diverting from the San Juan River, the lowest of Mexican tributaries, at a point where backwater from the Rio Grande is always present, even at low stage. Such a canal, without touching the Rio Grande, would draw away the greater portion of its low water flow some twenty miles above all American diversion points. This proposed Mexican canal will command practically all of the irrigable land on the south side, several hundred thousand acres in extent, and comprising some of the finest lands in the Republic. On another large tributary, the Concho, there is a considerable area of irrigable land. It has been reported that Mexico has granted concessions for the irrigation of about 150,000 acres in the Concho valley. The Concho is at present an important source of low water flow in the lower Rio Grande.

MEXICO has no occasion for concern over her rights in the Rio Grande. So long as no extensive irrigation is attempted on the opposite side of the river, the only immediate problem facing the American irrigators is to develop additional water resources to keep pace with the expanding cultivated area. But it does not take a very long look ahead to recognize the possibility of complications that may greatly disturb the present status of things. So long as the shadow of Mexican appropriations hangs over the head of the Delta farmers, there must be a feeling of insecurity and a cloud on the title to the fundamental necessity of all industry there.

Fortunately, there are available storage sites which offer the opportunity to increase the irrigated area at least four times that which can be supplied from the normal flow alone. However, these

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What Irrigation Has Done For My State—*UTAH*

By O. W. ISRAELSEN

DR. ISRAELSEN is Professor of Irrigation and Drainage at the Utah Agricultural College, Logan, Utah. His is the third of a series of articles to be presented in MODERN IRRIGATION, *in which eminent westerners will tell what irrigation has meant to their respective states.*

IRRIGATION has made Utah possible. Of course, the 52.6 million acres of the earth's surface known to geographers as Utah are obviously not dependent for their existence on irrigation. But Utah's 26,000 farms, its 200-million-dollar investment in farm land and buildings, its 23,000 farm owners, its numerous sugar factories, condensed milk factories, canning factories, vast alfalfa fields and alfalfa seed producing areas, its prosperous and contented rural population—all these component parts of Utah were made possible by irrigation.

Likewise, the most economical development of Utah's rich mining resources and its extensive coal deposits, the utilization of its grazing lands and its dry-farming possibilities; and finally, the enjoyment of the scenic beauty of Utah's mountains and canyons is greatly facilitated by irrigation, if not actually dependent on it.

IRRIGATION was early recognized as an effective agency in the development of a valuable spirit of co-operation among the Utah pioneers. The first canals were dug by the community, owned by the community and operated by the community. One of the chief functions of the town and city corporations in early Utah days was to clean irrigation ditches, maintain irrigation structures and distribute irrigation water. Even yet, in some Utah localities, the city corporation manages irrigation affairs, but most of the canals are now owned and operated by the farmers who use the water on their lands.

The growth of irrigation in Utah has been steady. During the thirty-year period from 1890 to 1920 the irrigated area has expanded from 250,000 to 1,370,000 acres, the latter being only 2.6 per cent of its land area. If the rate of expansion of the past thirty years continues during the next forty-five years, then Utah will be using all of its available water for irrigation. But even then only six acres of each 100 will receive irrigation water. True, the irrigated area is relatively small, but the irrigation of the six acres makes possible a profitable use of the ninety-four acres for other purposes. But the food production on the fraction of the irrigable land now irrigated is also really significant.

Irrigation has enabled Utah to produce twice as much wheat as her people consume. Since wheat is produced both on the dry-farms and the irrigated farms, let us look at some of the crops that depend wholly on irrigation. In 1924 Utah shipped across her borders, after supplying the home markets, 1054 cars of apples, 962 cars of potatoes, 483 cars of onions, 265 cars of tomatoes, 167 cars of cherries and many additional cars of mixed fruits and vegetables. By irrigation Utah produces annually more than one million tons of alfalfa which, in addition to feeding large numbers of beef cattle and sheep, constitutes the major food for 100,000 cows. In addition to supplying the milk and butter needs of the farm families, there is each year manufactured in factories from the milk of these cows more than 7 million pounds of butter, nearly 3 million pounds of cheese and over 33 and one half million pounds of condensed milk.

Irrigation has also enabled Utah to help maintain the "sweet standards" of the nation. From the one million tons of sugar beets annually produced on Utah's irrigated land, enough sugar is made to supply more than five times her population, provided the annual per capita consumption does not greatly exceed one hundred pounds. And finally, there is produced on Utah's irrigated land nearly one-half of all the alfalfa seed grown in the United States.

THUS, irrigation has made it possible to provide, in Utah, happy and prosperous homes for approximately half a million people who are producing large surplus food supplies for the rapidly growing national population. And it is important to remember that the lands which support these homes and produce this surplus food were considered worthless only 100 years ago.

Today, those least informed concerning agriculture under irrigation are asserting that these great accomplishments under irrigation can at best be temporary; that the arid soils are rapidly being exhausted of their fertility, and that a civilization dependent on irrigation for its food supply cannot endure. Contrary

O. W. ISRAELSEN

to this misconception, irrigation has made it possible actually to increase and to make more permanent the fertility of Utah soils. It is true that excessive application of irrigation water on some of the higher lands, and seepage losses from high canals, have caused water-logging of significant areas of low lying land, but these areas are rapidly being reclaimed by drainage. On the other hand, irrigation has facilitated crop rotation and the growth of nitrogen fixing legume crops, and the practice of livestock and dairy farming, all of which have done much toward increasing the fertility of Utah's soils and the establishment of its agriculture on a permanent basis.

And, finally, irrigation has done much for the citizens of Utah. The irrigator, of necessity, has acquired skill in the control of water on his farm. He has learned to receive water from his canal in his turn, and to restrict his use during periods of scarcity. While those who are entitled to the earlier water rights guard their rights cautiously, yet in many instances during times of low stream discharge, they have voluntarily turned their streams on to the burning crops of the less fortunate holders of late priorities.

Likewise Utah's legislators, her attorneys, her engineers, her statesmen, and others of Utah's citizens, have found great advantages in maintaining the spirit of co-operation which irrigation has fostered, and which has made itself vitally felt, in the final analysis of the many perplexing problems and controversies which naturally have developed in the growth of a state that is inherently dependent on irrigation.

The EDITORIAL

MODERN Irrigation

An Organized Voice for the Forces of Agriculture and Industry Which are Primarily Dependent upon Irrigation.

Published Once a Month
AT LOS ANGELES, CALIFORNIA, BY THE
PETROLEUM WORLD PUBLISHING CO. *Editorial and Executive Offices, 626 South Spring Street, Telephone Broadway 3262.* Branches: SAN FRANCISCO—447 SUTTER STREET, *Telephone Garfield 2772;* H. E. TAYLOR, *Manager.* CHICAGO—1163 MONADNOCK BLDG., *Telephone Wabash 8855;* JOSEPH E. O'CONNOR, *Manager.* NEW YORK,–56 W. 45TH STREET, ROOM 1105, *Telephone Vanderbilt 8753;* WERNER HAUPTLI, *Manager.*

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By Annual Subscription in the United States and possessions, $2.00; Foreign, $2.50; Single copies on sale in the irrigation country, 20 cents. In ordering change of address, give both the old and the new address. Allow ten days for re-entries on the subscription list. Advertising rates and circulation data upon request. Checks should be made payable to Petroleum World Publishing Co.

Vol. II APRIL, 1926 No. 4

More Sides Than a Few

OFTEN asserted, always accepted, but seldom appreciated is the statement that irrigation is a many-sided subject. In this, as in so many other cases, repetition dulls the edge of truth. There is no dissent from the fact, but there is—perhaps—a lack of imaginative response to all that is implied by the often reiterated statement.

The present difficulties of federal reclamation may be traced, for the most part, to a failure to understand this many-sidedness of irrigation. It was conceived, at the outset of Federal reclamation, that if the engineers would plan and the contractors would build and the government would finance, water and land would be brought together into that ideal union that would have its issue in prosperous, productive, and populous agricultural communities. It has not always been so. Today it is recognized that reclamation is a success only where its many-sidedness was recognized; and where all the factors, either as they have been affected by good luck or good management, received their proper consideration.

The same fault lies at the root of the incomplete success of all agriculture. Farming under any climate, or under any set of conditions, is sufficiently complex. The regrettably low estate of the farmer of yesterday (and today, to a less extent) finds its explanation in a failure to recognize that complexity. A farmer without technical instruction, and often without adequate capacity, was faced with a task which, for its successful consummation, demanded more than a rudimentary knowledge of the economics of supply and demand, the business management of invested capital and employed labor, the physics and chemistry of soils, the biology of plants and of their vegetable and animal parasites, and the financial principles of funding, amortization and marketing. That the farmer, in so many cases, succeeded in solving these problems in a primitive hit-or-miss fashion makes the accomplishments of agriculture the more astounding.

We can see these defects of the past plainly. The defects of the present, originating in the same short-sightedness, are perhaps less evident. They are none the less a fact. The irrigationist readily concurs with the assertion that all of the many factors must have their proper weight in the equation, but too often he proceeds to construct a formula of his own, leaving out some of the most essential ones. Even in current irrigation developments, there is a tendency to hold that a fertile soil, plus an available water supply at an economical cost, plus an adequate complement of competent settlers, are the only prerequisites to feasibility. This is the largest part of the story, it is true; it is an advance over the old theories that water ought to be brought to the land wherever arid land might be supplied with water. But it is not all.

MODERN IRRIGATION is not opposing the extension of irrigation, for it believes fully and sincerely that the "saturation point" is not yet approached, and, in fact, never can be approached. Feasible and successful districts are always in demand and always will be. But projects undertaken without due consideration of the factors of soil fertility, financial feasibility, and a practicable settlement policy, work irreparable damage not only to themselves, but to all other irrigation developments, not to speak of their regretable results from the standpoint of the human element—the disappointments, the hardships, the life failures of those who give their labor and ambition to a project which can not return a fair dividend upon that investment.

But it needs to be recognized, not only in words but in a revision of current conceptions, that construction is not synonymous with irrigation. The engineer, whose tasks bring him so closely into touch with the other factors, and the ultimate success of whose work must depend upon these other elements, ought to be the first to recognize the fact.

MODERN IRRIGATION is the magazine of applied hydraulics; its interest includes construction as one of the important phases of irrigation and water development; but it is not limited to construction. Its

POINT *Of* VIEW

purpose is to spread information on all aspects of the great industry; the conservation of water supplies for tomorrow as well as their use for today; the management of going projects as well as the survey of new ones; the law of hydraulics as well as the technical principles of its application; the economics and finances of the district, the company, and the individual farmer; drainage, politics, management of men and money—all these things that enter into the thoughts and successful work of the industry and its individual members.

Absorbing and Confusing

NOTHING is more absorbing to one interested in the vagaries of irrigation legislation than to follow the congressional career of the Swing-Johnson bill. At the present time the measure is once more before the Senate Committee on Irrigation and Reclamation, where some of its friends and a few of its enemies are busy writing in and rubbing out proposed amendments. The next few days should reveal whether or not action may be expected during the present session of Congress.

Both as a spectacle, and as an important decision in the annals of the southwest's development, the fortunes of the Swing-Johnson measure are worth attention. But one of the most intriguing things about it is the attention accorded it in the newspapers.

The largest number of people to be vitally affected by this measure live in Los Angeles. They are served by newspapers adequate in number if not in content. Most of them gain from the newspapers—or, more usually, from one newspaper—all the information which they get on this subject, or any other matters of public concern. The interesting thing is that they get only the type of information that the directing geniuses of these newspapers are inclined to give them.

Two morning newspapers, the estimable *Times* and the eminent *Examiner*, make a practice of "playing up" Colorado River news. The reader who resorts to them for his information, however, may know in advance what he will find. Day after day, one may refer to the one journal and find that the advocates of the Swing-Johnson bill have swept aside, in one astute and strategic move, all obstacles and opposition, and must now meet only a few minor technical requirements before swinging triumphantly through to victory; and, turning to the other periodical, discover that, at the same time, that ill-fated measure has all but perished of its own weakness, succumbing to the accumulated opposition of its powerful adversaries, and now hangs on, a dead issue, supported by the waning efforts of a few selfish protagonists.

The facts behind the two stories are the same—slender enough it is true—but sufficient to serve as the skeleton around which the journalistic prestidigitators of the modern newspaper can construct a most entertaining body of deception.

This, of course, is an indictment of all journalism of the present day, to a greater or less extent, but it applies particularly to the measure now under discussion. It is too bad. It is worse than too bad; it is tragic, in that it pictures the sincere advocates on "the other side" as selfish, mendacious brigands; it beclouds issues; it obscures the truth.

Let There be Light

A LACK of frankness is one of the things that has made the Colorado River controversy so bitter and so prolonged. There has been too much shouting about principles, on both sides, when only selfish interests were the motives.

For instance, one feature that is typically hedged about with half truths, is the All-American canal. In a letter to a prominent Californian, reproduced in this issue, Elwood Mead, Commissioner of Reclamation, after pointing out some of the international considerations which affect the actions of the federal government with relation to the Colorado River and the Rio Grande, and showing that such actions must be courteous and circumspect on account of the strategic situation of the Latin republic in relation to both rivers, says: "The people of the Imperial Valley, or of Los Angeles, do not seem to realize the precarious situation."

The people of Imperial Valley have a fairly good understanding of the physical features of the problem, because it is always with them. The greater part of the people of Los Angeles do not have even a rudimentary conception of the physical features, let alone the complex considerations of other kinds which it involves.

The All-American canal has been urged by its proponents under the banner of patriotism and principle, as an urgent, vital necessity to the independence of the United States and the maintenance of the peace and dignity of the Imperial Valley. And all the time, many of those who have contended for it on such an extravagant basis, have privately conceded that it ought to be considered merely as a possibility—a demand to be conceded in negotiation—valuable in bargaining but not indispensable as a physical fact.

As with the Swing-Johnson bill, this magazine neither advocates nor opposes the All-American canal. There are strong considerations—valid considerations—on both sides. But it does conceive that it is poor policy for the advocates of the canal to base their plea on any other ground than that which candidly actuates them.

The people do not understand the situation because they are not told the truth. The newspapers will not tell them. They have their own axes to grind. The pros and the contras each shout their own prejudiced story from the housetops, and in the confusion, the man in the street hears little but their accusations of each other.

Keeping Pace With Irrigation

How the Future Development of Irrigation Presents New Problems and New Fields for the Work of the Division of Agricultural Engineering

By W. W. McLAUGHLIN

Associate Chief, Division of Agricultural Engineering, Bureau of Public Roads, U. S. Department of Agriculture

UNDER the heading "An Outline of Irrigation," Mr. McLaughlin told in the March issue of MODERN IRRIGATION *the story of how the present form of organization of the Division of Agricultural Engineering has developed from a simple inquiry into irrigation practice, launched by Congress in the early nineties, and how the functions of that department have been extended as the problems of irrigation and reclamation have become more complex and difficult. In this issue he looks into the future, and discusses the work of his Division with relation to its usefulness in solving the present and future problems of reclamation and irrigated agriculture.*

A KEEN observer of reclamation development, in a recent article, stated that in the immediate future of reclamation there are three general fields involved; that of purely engineering, that of finance, and that of the agricultural engineer. The engineer will deal with those larger problems of engineering. The financial agency will have to devise ways and means of meeting the construction costs and provide a feasible way for the repayment of these costs. The agricultural engineer will have to do with other problems involving the use of the land and water by the farmers.

It will be his field to determine the economic feasibility of the project as outlined and to suggest, should occasion demand, such changes in this plan as may make the project feasible and economical. It will be his lot to balance the cost of land and water, together with incidental development, against the estimated returns and to suggest such changes in terms of repayment of construction charges as can be met by the farmers from the proceeds of the land.

During the past thirty years there have been a great many changes in irrigated agriculture. Pioneer farming is almost a thing of the past and the farming of today is a problem of business. In the early days it was very largely a question of providing sustenance for man and beast. The successful farmer of these times must produce quality as well as quantity and is competing not alone with his next door neighbor but in many instances with his competitor in foreign countries.

The function of the Division of Agricultural Engineering is also changed. During the early years and in fact until rather recently the principle function of this division was to secure and impart the best existing practice in irrigation farming. Such information was disseminated through the press, lectures, personal contact or bulletins. In the more recent years our work has been very largely research for the purpose of determining fundamental principles of irrigation rather than to study existing practices. These research findings are made public by means of bulletins or through the extension departments of state institutions or the federal government.

Our immediate work for the future will be to continue most of the present projects of investigation and research, but with the special reference to the economic features and a better utilization of our water resources. Without going into detail the following list of projects will give you an idea of our present work in reclamation:

Duty of Water.
Loss of Water by Evaporation.
Development of Ground Water for irrigation.
Preparing Land for Irrigation and Methods of Applying Water.
Seepage return due to irrigation.
Irrigation needs and possibilities of the Great Plains.
Effect of Ground Water on Crop Production.
Utilizing Early and Late Water in Irrigation.
Appliances and Equipment for Irrigation.
Control of Silt in Canals and Reservoirs.
Control of Gravel in Streams during High Water.
Cleaning and Maintenance of Canals and Ditches.
Measurement of Water.
Flow of Water in Conduits.
Sale and Settlement of Land and Cost of Farming under Irrigation.
Irrigation Institutions.
Drainage of Irrigated Lands.
Reclamation of Alkali Lands.

Our future work in studies of cost of irrigation farming and development will include further research into permissible costs for irrigation water supplies and costs of and returns from irrigation activities. There will be continued the study of water requirements of the soils and crops with special reference to better utilization of water in irrigation. The studies in utilization of water will include water development and storage, pumping and reorganization of existing irrigation systems. Special attention will also be paid to drainage problems and the reclamation of alkaline lands.

To my way of viewing the im-

Mr. McLaughlin Says:

Farming today is a problem of business; pioneer farming is almost a thing of the past. The successful farmer must produce quality as well as quantity. He is competing not alone with his neighbor, but with foreign countries.

The field of greatest service is in solving the problem of bettering conditions in going enterprises. This does not imply opposition to new enterprises which are economically sound.

In one district. . . . water is raised 325 feet by means of pumps, while at its north end there is flowing a stream of water used in the irrigation of lands lying below the lands served by the pumping plant. The water in this stream is flowing down through 300 feet or more in elevation before being raised that distance by means of pumps. Such cases as this require the assistance of outside aid. Such work offers the opportunity for the future efforts of our Division.

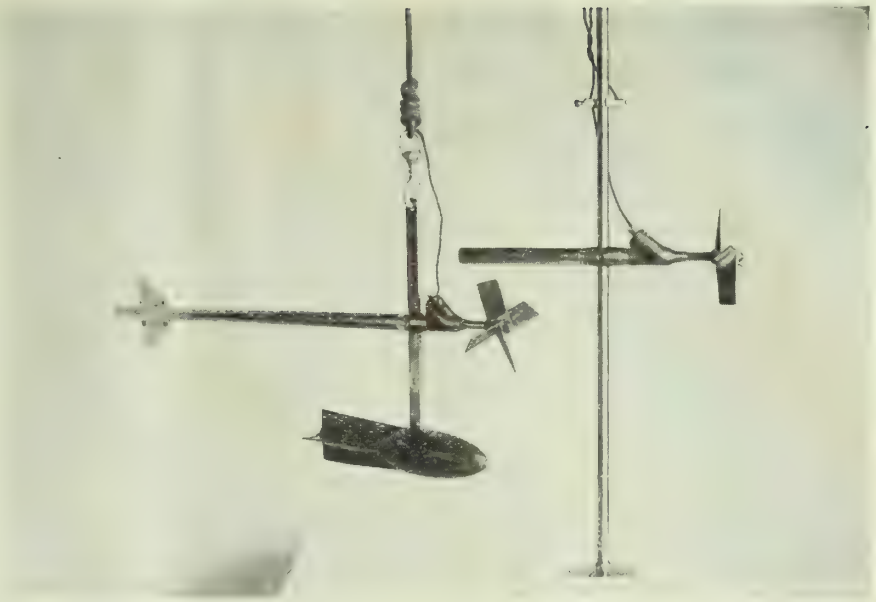
mediate future in reclamation development in the west, the field which offers the greatest possibility for real service with the least chance of failure, is in solving the problem of bettering existing conditions in going enterprises including not only the lands within these going enterprises but additional lands that may be developed in the bettering of conditions affecting lands within the going enterprises.

This betterment may consist in securing by storage or otherwise a supplemental water supply for use in summer and early fall, by reorganizing existing systems, thereby utilizing to better advantage the present water supply, by making possible additional financing or by outlining a different farm program or a change in organization or in methods of operation and maintenance, as well as in numerous other ways.

Do not understand me to oppose the promotion of new irrigation projects that are economically sound; but I believe there is a greener field at present and one more likely to succeed, which is exemplified by such development as is now being undertaken under the American Falls project or that being started under the Salt Lake Basin Project in Utah. Under such projects as the Great Salt Lake Basin the problems of land settlement and colonization and farm financing which have been the stumbling blocks in so many irrigation projects, are much reduced.

Let us illustrate the problem by considering a unit of the Great Salt Lake Basin project, that unit embracing the Cache Valley. This Valley contains approximately 175,000 acres of irrigable land south of the Utah-Idaho line. There is at present under irrigation 95,000 acres and about one year out of five there is a serious water shortage in the later summer and fall even in this, one of the best watered valleys in the inner mountain countries. The cost of soring water for the supplemental irrigation of the lands of this valley is beyond the financial resources of any single irrigation company, and in fact is of such magnitude that to make it effective it has to become a community problem.

To operate as a unit would require a suitable single parent organization, such for instance as an irrigation district or water conservancy district. The proper utilization of the waters of the community would demand the use of the water from those lands which could be best served by any stream or spring irrespective of present ownership when considered in conjunction with the supplemental supply. This, therefore, would involve an exchange of water rights to work out an adequate system; it would require a comprehensive view of the agricultural and engineering problems of the entire valley; it would demand a comparison of the total and unit returns for the lands now under irrigation it would require a comparison of estimated returns with present returns based upon the additional cost under the proposed development. The study would not only involve the individual farmers in the single canal company but would have to consider the community as a whole. The manager, the state, and the community would be interested from the standpoint of increased production and wealth, as well as bringing under irrigation additional acres.



The Division of Agricultural Engineering is working on problems of water measurement as an important phase of irrigation research. This is the new type "Hoff" meter for measuring stream velocities, designed and developed by E. J. Hoff, of the Division.

Various types of measuring devices are continually being developed and tested by the Division. This is an improved Venturi Flume, with 3-foot throat section, installed on American Beet Sugar Company's farm, near Fort Collins, Colorado.

NO QUESTION of colonization in this valley, or serious problem of financing the new settlers would be involved. There has already been determined the type of agriculture best suited to this region and the possibilities of the valley from a productive standpoint are proven. Estimates can be based upon past accomplishments—upon facts rather than upon assumptions and guesses.

(*Continued on Page 33*)

Mead, in Letter to Chester Rowell, Comments on River Problem

THE RELATION of the proposed all-American canal to the probability of Colorado River legislation, and the importance of the international conflict of interests on the Colorado River and the Rio Grande, are emphasized from a most interesting point of view in a letter from Elwood Mead, Commissioner of Reclamation, to Chester Rowell, influential California publicist and political power, which has recently been made public.

Dr. Mead's letter, in part, reads as follows:

"The secretary's recommendations in the first letter and reiterated in his second, that the all-American canal should be coupled with negotiations with Mexico, has a much more vital relation to the passage of this legislation (the Swing-Johnson bill) than the people of Southern California seem to realize.

"For months past, correspondence has been going on between this country and Mexico relative to an international water-right agreement on the Rio Grande and Colorado rivers. On the lower Rio Grande there are 200,000 acres of land on the Texas side, irrigated with water 85 per cent of which comes from Mexico.

"Mexico can use all the water rising within its own territory on its own land. But to save these American farmers and the millions invested we must induce Mexico to recognize the rights of prior users in this country.

"Over on the Colorado the situation is reversed. There are 200,000 acres of land irrigated in Lower California with water that comes wholly from the United States. I believe the prior rights in both cases should be protected, but we can only do that through an international agreement by which both of these streams will be dealt with together.

"It is of the utmost importance, therefore, that nothing be done to interfere with these negotiations.

"To announce that the government was going to build an all-American canal without any consideration of the rights of Mexico in the Colorado is, to say the least, lacking in tact or courtesy. That all-American canal, connected with the reservoir, would enable all the water to be taken out before it reached Mexico. Building it with no effort to reach an understanding would be regarded by Mexico as evidence of intent to do this.

"This is not conjecture. We know how this matter is regarded at the Mexican capital. At present the Imperial valley is being irrigated and the levees protecting its lands from overflow are being operated and maintained through the courtesy of the Mexican government.

"An act of aggression on our part, such as some of the people of California seem to favor, might lead to a reprisal on the part of Mexico that would interfere with the operation of these works.

"Imperial valley depends on and must depend on the operation of the canal and levee system for several years. It seems much more sensible, more courteous, therefore, to approach this matter as the ecretary has done. It will help to prevent destructive reprisals which Mexico is capable of putting into effect both on the Rio Grande and the Colorado. The people of the Imperial valley, or of Los Angeles, do not seem to realize this precarious situation.

"There is another phase of this matter. The people of the east, to whom Imperial valley is remote, have important relations with Mexico in oil, lands and trade. Immediately after the secretary's first letter I received a letter from a former secretary of the interior expressing a belief that the secretary's first letter did not give proper consideration to Mexico's rights and he insisted that our willingness to act fairly should be made so plain that no one could question it.

"What the secretary has said does not menace the building of the all-American canal if needed. It has made influential friends for the legislation in this part of the country."

Colorado and Rio Grande--Rivers of Doubt

(*Continued from Page 18*)

sites can not be utilized, nor the title to the water which is stored protected, without a treaty. A special water treaty with Mexico is therefore the fundamental need of the American farmers on the lower Rio Grande.

The right to the water now being used can not be protected, nor can their increasing needs be provided for except through a new treaty. The American need for such a treaty is pressing. On the other hand, Mexico has no immediate concern in such a treaty.

It is true that, ultimately, neither country can enjoy the fullest benefits from the stream without some mutual agreement which will permit of a comprehensive system of storage and distribution, but until Mexico has occasion to use the resources of the Rio Grande, she may remain indifferent and postpone any settlement until the United States is forced to concede terms that may be satisfactory to her but disastrous to American interests.

When, in the course of the diplomatic correspondence which arose out of the creation of the American commission on the equitable use of the waters of the Rio Grande a little over a year ago, Mexico proposed that the inquiry be extended to include the Colorado river as well, a new situation was brought about. The remarkable situation which exists on the Colorado has been so widely discussed in late years, that it is unnecessary to go into details here.

Undoubtedly Mexico, at the present time, is in an even more strategic position on the Colorado than on the Rio Grande. However, if the works which are contemplated in the proposed Colorado River bill are carried into execution, the physical control of Colorado water will be transferred absolutely to the United States. Mexico occupies a very different position on that stream, inasmuch as she has an extensive development dependent on its water resources. The authorization of an All-American canal would create a menace to this development unless Mexico's present use of this water should be made secure by treaty.

In view of this new situation, Texas is looking toward the far west with considerable interest. It sees in the All-American canal provision of the Colorado River bill an opportunity to place the Rio Grande question on a basis where it will not be quite so one-sided. The United States must rely largely on the principle of priority to protect its Rio Grande development, while Mexico must invoke the same principle to protect its Colorado river development. By disposing of international questions on both streams in one settlement some common principle could be applied which would properly recognize the equities of both countries.

If those states most interested in securing the development of the Colorado, with the all-American canal, are willing to consider a friendly alliance of interest with Texas, and concede the common interest which the two regions have in a treaty settlement of Mexico's interests in both the Colorado and the Rio Grande, the latter state is disposed to look upon the All-American canal with almost a personal interest. In that fea-

ture lies the hope that this country may be able to enter into negotiations regarding both of these streams upon something like equal terms with Mexico.

IT SEEMS to be generally conceded that Mexico is to be given every consideration that justice and equity demand, when the final disposition of her claims to Colorado River water is made, even though the new works which are contemplated might make it physically possible to cut off her water supply completely.

While the rules of international law might justify such a course, international comity might not. By a joint settlement of both streams, therefore, no sacrifices are demanded of American interests on the Colorado that would not be conceded in an independent settlement. But thereby Mexico would be placed in a position where she must adopt the same broad and liberal attitude toward American equities in the Rio Grande.

In short, by a joint settlement, both countries would be impelled to take a fairer view of the other's claims than would be the case if each stream was to be disposed of by independent treaties, each of which would have to be approached from a position where one party had the advantage.

Texans do not feel that they are the sole beneficiaries of this suggested community of interest. From this point of view, the problems of both streams are lifted out of the realm of purely local concern and are given national significance and scope. National interest can not tolerate a foreign menace and domination over two of the most productive and fertile sections on the continent. So long as the present status remains, the continued existence of these two similar, but widely separated communities, remains in doubt. The Colorado River bill, with its All-American Canal provision, takes on added significance from the standpoint of the nation at large. Without some adjustment of the problems of these two rivers they are certain to become more and more a source of friction between this country and our neighbor on the south.

If Texas be joined with the proponents of the Colorado River plan in ties of common interest, it can bring to the union a large measure of prestige and influence in Congress. With its 18 members in the House, including the ranking Democrat and dean of his party, Hon. John N. Garner, who represents the lower Rio Grande district, probably no state wields a greater influence on the Democratic side of the House than the Lone Star State. In the possibility of a union of forces of this kind, between these two sections of the irrigated southwest, there are implicit far-reaching potentialities for influence upon the shadow of doubt that now hangs over these two great international rivers.

Imperial District's Directors Dispute Over Employees

C. W. Brockman, minority member of the Board of Directors of the Imperial (California) Irrigation District, precipitated an interesting situation in March when he introduced before the board a resolution calling for the reduction of salary or discharge of seven employees of the district, whose duties he asserted to be partly or mainly political ones. Mr. Brockman's action followed the dismissal of certain employees of the district, who were discharged some weeks ago following the ruling of a California court which held that the hiring of employees to influence legislation was outside of the legal powers of an irrigation district.

Mr. Brockman's resolution did not come to a vote before the board of directors, the majority of whom are not in agreement with him, failing for the want of a second. An answering resolution, introduced by another member of the board in response to the Brockman resolution, however, was seconded and passed.

In the latter resolution, which constitutes a rejoinder to some of the allegations made by Mr. Brockman, the board denies that the duties of the employees in question are wholly, or in any considerable part political, setting forth at length the nature of the respective services performed by each, and asserting that each of the men in question is serving the district efficiently and well. In amplification of these denials, the resolution shows that the monthly payroll of the district has shown a steady decrease since the recent re-organization, as compared with corresponding months of the previous year.

The employees named in the Brockman resolution are: C. M. Berry, purchasing agent; Charles L. Childers, chief counsel; A. C. Finney, associate counsel; A. E. Kellog, deputy collector; Carleton D. Joy, assistant secretary; John W. Scott, assistant purchasing agent; George Whitlock, right-of-way.

Whose Water

(*Continued from Page 12*)

in Shasta County, from which about 2200 acres are irrigated.

West Fork of Carson River in Alpine County from which about 5000 acres are irrigated.

Hat Creek in Shasta County, from which about 2500 acres are irrigated.

Oak Creek in Inyo County, from which about 1700 acres are irrigated.

Burney Creek in Shasta County, from which about 2500 acres are irrigated.

One proceeding referred by the superior court of Lassen County and including the water rights covering about 3200 acres of land irrigated from Red Rock Creek, was abandoned after it became apparent that a final settlement could not be made within any reasonable time because of involved land ownerships and other pending litigation.

The pending adjudications cover all water rights on the following stream systems:

Stanislaus River in Alpine, Calaveras, Tuolumne, Stanislaus and San Joaquin Counties, from which about 150,000 acres are irrigated.

Whitewater River in Riverside and San Bernardino Counties, from which about 18,000 acres are irrigated.

North Cow Creek in Shasta County, from which about 1800 acres are irrigated.

Oak Run Creek in Shasta County, from which about 500 acres are irrigated.

Shasta River in Siskiyou County, from which about 40,000 acres are irrigated.

Owl Creek in Modoc County, from which about 3000 acres are irrigated.

Soldier Creek in Modoc County, from which about 1900 acres are irrigated.

As indicative of the beneficial results accomplished through adjudication proceedings, it should be noted that the Division has undertaken five proceedings in Shasta County alone, all of which were initiated by court reference. Three of these, covering the North Fork of Cottonwood Creek, Hat Creek and Burney Creek, were settled by agreement of the claimants after the physical facts had been determined and presented in the form of maps and reports. In the other two cases, covering North Cow Creek and Oak Run Creek, tentative allocations of the water supplies have been agreed to by all of the claimants, with the understanding that the waters are to be distributed in accordance therewith throughout the 1926 irrigation season by a water master, to be appointed by the Division, and it is believed that such action will afford the basis for equitable final settlement in the two cases.

In recent years there has been an ever-increasing demand upon the Division for information relative to the adjudication procedure. Requests for information have been received from all parts of the state, and from parties contemplating new developments who realize that the success of their plans will be dependent upon a knowledge of the extent of vested rights and proper steps to protect the same, as well as from the owners of old vested rights who fear encroachment by new appropriations. It seems certain, therefore, that as the development of the water resources of the state proceeds, an increasing number of water users will avail themselves of the adjudication procedure provided in the Water Commission Act, in order to establish titles to their water rights and to make such titles secure.

THE HYDRAULIC DIGEST

A Monthly Bulletin Board of Brief Facts and Events from Far and Near

Reject Santa Cruz Bids

All bids tendered on the Santa Cruz, New Mexico, irrigation project, which were opened on March 11, were rejected as being too high, and another call for bids was issued. The estimated cost of the project is $250,000.

Vote Water Bonds 10 to 1

Residents of Willowbrook, near Long Beach, in Southern California, voted their approval of the issuance of $70,000 in bonds for the construction of a water system, during March, by a majority of ten to one.

Senate Passes Norris Bill

The "Norris Bill," providing for closer co-operation between the federal department of agriculture and the various states in the protection of forest lands, reforestation, and extension of the national forests, has passed the Senate and goes to the House for action.

Everett to Vote on Bonds

Voters of Everett, Washington, will ballot in May on a proposition providing for the acquisition, by the city, of Flowing Lake and watershed, construction of a three-mile pipe line from Flowing Lake to the Sultan supply line, and issuance of $260,000 in revenue bonds to accomplish the work.

Refunding Issue Anticipated

The Payette-Oregon Slope Irrigation District, Oregon, is planning to issue a refunding bond issue in exchange for the outstanding issue of $64,000, which becomes due this year and which the district is not expected to meet. Carstens & Erle, Seattle firm which originally purchased the bonds, has agreed to circularize the holders of the bonds urging acceptance of the refunding issue.

Start Girard Water System

Department of Water and Power of the City of Los Angeles has started work on the construction of a water system for Girard, San Fernando Valley community, which will cost $275,000. The system will include 27 miles of pipe, varying in size from four to twenty inches in diameter, and a reservoir of 284,000 gallons capacity.

Concreting Work Finished

Concreting of canals of the Roosevelt Water Conservation District (Arizona) has been suspended for the season, the last canal to be lined being the south canal, main intake for the south side of the project. Within a short time the main pumping plant of the district will be in regular operation. Concrete lining operations will be resumed next winter, when the big job will be completed.

Kittitas Plans Advanced

It was announced by the Yakima office of the Bureau of Reclamation during March that the development of the $7,500,000 Kittitas high line project would be directed as a separate unit, divorced from the control of the Yakima office. The soil survey work of the project has sufficiently progressed to justify the statement that the irrigable acreage under the project will amount to 75,000 acres.

Yakima Buys Water Properties

City commissioners of Yakima, Washington, have authorized the sale of $100,000 of general obligation bonds, the funds from which will be used in the purchase of the Oak Flats site, proposed intake, rights of way and reservoir site. It is expected that this step will remove the objections which resulted in the recent failure to sell the issue of the city's $1,050,000 worth of utility bonds based on the values to be created in the new water system.

Auburn System Near Ready

The Coal creek water system, now being constructed for the city of Auburn, Washington, will be completed by May 1st, according to a report by J. A. Fallgreen, city engineer. The project is well ahead of schedule and will be finished comfortably ahead of the date originally set. The city will celebrate the completion of the system by a special municipal holiday, in which opportunity will be given for inspection tours over the whole system.

No Pay, No Water, Says Mead

Elwood Mead, Commissioner of Reclamation, announced on March 30 that water users on federal reclamation projects who are more than one year in arrears in their payments on water charges will not receive water this season until their claims have been satisfactorily adjusted with the government. He stated further that the notes of individuals or of the irrigation district, or crop mortgages will be acceptable as payment.

Pine Flat Report Near

The scheme for the creation of a super-conservation and irrigation project in the central San Joaquin Valley, California, commonly called the Pine Flat project, is nearing the point where definite steps may be taken leading to the calling of a bond election, it is stated, as the preliminaries of a survey by a special engineering committee, headed by George L. Swendsen, were nearing completion. This committee has been at work since September, 1925, in the compilation of data on the resources of the Kings River area, and expects to report in April.

Urge $2,000,000 Reservoir

Construction of a large reservoir and dam in the Glen Park district of San Francisco, for the protection of the city from possible failure of delivery by the Hetch Hetchy project has been urged by M. M. O'Shaunessy, city engineer of San Francisco. Pointing out that present reservoirs within the city limits would provide water for the needs of San Francisco for only three days in the event of temporary failure of delivery of water, Mr. O'Shaunessy recommends the construction of a dam of 500,000,000 gallons capacity, with an estimated cost of $1,750,000 for the dam alone.

Ojai Valley Plans Project

Plans for the development of a $2,000,000 irrigation project to supply water to lands in the upper Ojai (California) Valley were revealed in March when application was filed with the state division of water rights seeking permission to appropriate 30,000 acre-feet of water in the Santa Clara River watershed. Application was filed by Guy T. Stetson and Henry S. Nixon as trustees for the Ojai Irrigation District. The plans for the project call for the building of a dam in the Sespe Canyon and tunnel to carry the water through the mountains to the Ojai.

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Glenn-Colusa District May Build $2,000,000 Dam

Manager Durbrow Announces Plans for Project to Generate Power and Save Pumping

Construction of a $2,000,000 diversion dam on the Sacramento River (California) near Hamilton City, resulting in the generation of 13,000 horsepower and the elimination of the present pumping plant of the Glenn-Colusa Irrigation District is contemplated in an announcement made in March by William Durbrow, general manager of the district.

In his statement, Mr. Durbrow states that the application for permit to appropriate 300 second-feet, which the district has filed with the state Division of Water Rights, is merely a preliminary move paving the way for a complete investigation of the feasibility of the project.

His statement follows:

"The Glenn-Colusia Irrigation District has made an application to the Division of Water Rights for a permit to appropriate 300 second feet of the flow of the Sacramento river for power purposes.

"The proposed project would entail an expenditure of $2,000,000. The gravity diversion dam would be put in across the Sacramento river at the present location of the pumping plant of the district near Hamilton City.

"The upper nine miles of the district's central canal would be enlarged, and approximately at Nine Mile the water would be dropped back into the Sacramento river through a power plant, which would give a drop of approximately thirty-eight feet and the generation of about 13,000 horsepower.

"The application for a permit to the division of water rights is in this case simply a preliminary step to an investigation as to the feasibility of the project.

"While there has been no navigation of this portion of the river for some ten or fifteen years this project would undoubtedly bring up a conflict as to the question of the navigability of the upper regions of the river. The project, however, does not necessarily mean the abandonment of such navigation, but might be used as a unit in the canalization of the river.

"The Glenn-Colusa Irrigation District's chief interest in this matter is the possibility of paying for a gravity diversion dam through the sale of power making for the district a great saving in its present pumping costs.

"Such a project would also be of interest to other districts taking water out of the Sacramento river on both sides, which through the diversion dam would be enabled to get gravity water to their lands rather than through the present costly process of pumping from the river.

"While no plans have as yet been made as to the use of the power to be generated by this plant the preliminary estimates will be based upon the sale of such power at a going rate to some distributing company."

Suggests Simple Method of Determining "Draw-Down"

Madera Man Uses Weighted Rubber Tubing as Apparatus; Lungs Do the Rest

D. Stephenson, a Madera (Calif.) plumber, has several inventions to his credit, the latest of which is a simple method of determining the "draw-down" in a drilled well, in which a deep well turbine has been installed.

Mr. Stephenson and the Apparatus

Instead of the more expensive and complicated method of using a hand-pump, in conjunction with a vacuum or pressure gauge, or any one of several types of electrical contrivances, ¼-inch rubber tubing, weighted with two feet of copper tubing, is "fed" into the space between the pump and the well casing, while the pump is idle.

As the approximate water-level in the well is known, the tubing is lowered to that level and, by either blowing or sucking, the exact point of contact with the water is easily determined.

The tubing is marked at this point and the pump is started. After the pump has been running for several minutes, or for a sufficient time for the water to have lowered to its "pumping level," Mr. Stephenson again lowers the tubing—sucking at intervals at the end of it—until the tongue detects a slight vacuum. The tubing is again marked.

The distance between the two marks is the "draw-down." The distance from the first, or lower mark, to the lower end of the tubing is the static head and the distance from the second, or upper mark, to the lower end of the tubing is the "pumping head"—less friction.

For Detailed Listings, Branch Offices, Etc., See the Buyers' Guide to Leading Supply Sources—Pages 55-56

Irrigation Districts Association Meets at Merced

(*Continued from Page 13*)

Irrigation District, which seeks to enjoin the district from expending any funds of the district in presenting any case before any legislative body, and on his suggestion, the Association authorized its executive committee to file a brief on behalf of the Association in this case.

In the interest of forest conservation, the Association adopted the following resolution:

Resolved, That we are opposed to the ruthless denuding of the forests on the upper watersheds of our rivers and urge the Department of Parks and Forest Service of the Government to take such steps as may be necessary to conserve the timber and brush; to be more strict in the issuing of permits granting to lumber companies the right to cut timber, to the end that the run-off will be spread over a longer period during the summer season. And be it further

Resolved, that the secretary send a copy of this resolution to our representatives in Congress and to the heads of the Park and Forest Services.

Opposition to a tax on the revenues of publicly owned utilities, proposed before the last California legislature, was voiced in the following resolution:

Whereas, There was before the last Legislature of the State of California, Assembly Bill No. 4 and Senate Bill No. 7, providing for a tax upon the gross revenue of publicly owned utilities, and

Whereas, It is understood that the so-called Farm Legislative Committee will sponsor this same movement during the coming session of the Legislature,

Therefore be it resolved, That the Irrigation Districts Association of California, in session on this 12th day of March, 1926, again go on record as unequivocally opposed to such a measure on the following grounds:

1st, That it would be a serious blow to the principle of public ownership. The fact that public utilities supplying water are exempted shows that its authors are not consistent and do not have faith in the arguments which might be put forth to support the measure.

2d, That the whole theory of this amendment is inconsistent with public ownership and operation of public utilities. The public would be taxing itself to run its own business.

3d. That it is apparent by this amendment that, had all public utilities been included, it would have received little support. Therefore, apparently, only those were included that would work a benefit to now privately owned utilities that are supplying the public with electric power and other such services.

4th. That the power companies pay only seven per cent of their gross income in lieu of all other tax. The people living in communities owning and operating their own public utilities pay all the County, City and Irrigation tax. Therefore, if this amendment were to pass, it would be clearly a case of double taxation and a penalty on every community owning its own utility.

5th. That the rates which the private utility may charge for service are fixed by the Railroad Commission at a figure which will insure a return of 8 per cent on their investment, while no such protection is given publicly owned enterprises.

A plea for a more optimistic picture of federal reclamation, and an implied criticism of publicity that emphasizes the difficulties and failures of reclamation policies, were approved in the following resolution:

Whereas, Nationwide publicity regarding the United States Reclamation projects is prejudicing the public mind against Western reclamation and

Whereas, we believe the public is entitled to know some of the accomplishments of the Bureau of Reclamation from official sources, and

Whereas, we believe in the original plan of the United States Reclamation Service to perform a definite and necessary public improvement work in the West,

Therefore be it resolved, by the members of the Irrigation Districts Association of California, representing 4,000,000 acres of irrigated and irrigable land in California, in annual session assembled at Merced, California, this 12th day of March, 1926, that this association go on record as requesting such a definite program of publicity initiated by the Bureau of Reclamation as will fully and completely reflect the results achieved as a whole during the past twenty-three years by the United States Reclamation Service, and be it further

Resolved, that copies of this resolution be forwarded to the Honorable Calvin Coolidge, President of the United States, to Hon. Hubert Work, Secretary of the Interior, and Hon. Elwood Mead, Commissioner of Reclamation.

Indo-China Has Ambitious Irrigation Works

Indo-China has undertaken agricultural irrigation on a large scale. The works include a great dam in the delta of the Thanh-Hoa, which empties into the Gulf of Tonquin. It was completed in January, 1926, having been begun in 1918. It will be the largest irrigation system in the East except those in India. Besides the dam there is to be a chain of navigable canals sixty-eight miles long, 320 miles of large ditches and 970 miles of minor ones, not all of which are completed. The expenditures so far have been $2,300,000.

The Thanh-Hoa runs southeasterly along the foothills of the Song-Ma Mountains, the boundary between Tonquin and Annam. These heights are divided by valleys through which run streams that are dry in summer but in winter are raging torrents. It is to collect and combine these waters that the irrigation plant has been constructed. It is expected that conservation will produce water in plenty to irrigate the northern part of Annam during the dry season, which comes in June, July and August. They are expected to provide for the irrigation of 150,000 acres.

Rice has been the chief product of Annam, but of recent years cotton has been raised with success. The new irrigation works will make it possible to increase the area devoted to cotton and to aid the cultivation of sugar cane as well as rice in a densely populated part of the province.

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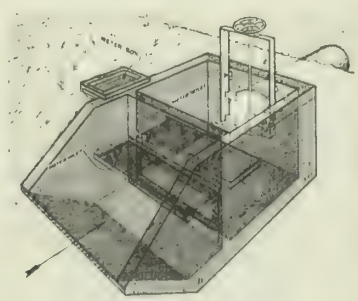

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MANAGEMENT

HOW MANY INCHES OF WATER IN A BUSHEL OF WHEAT?

By W. H. SNELSON

Senior Irrigation Specialist, Dominion Irrigation and Reclamation Service, Calgary, Alberta

DUTY OF WATER investigations extending over eight years, 1918 to 1925, inclusive, conducted at the Dominion Irrigation Experiment Station at Brooks, Alberta, Canada, have given results which are partially illustrated in the diagram on this page, showing the water requirements of Marquis wheat, as determined in the tests.

For the purposes of the tests this wheat was grown each year under several different conditions of soil fertility in order that data could be obtained relative to the effect of soil fertility upon the water requirements of the plant. The following table shows the position the wheat crop occupied in each of four different crop rotations.

Rotation D.—Red clover two years, *wheat,* barley.

Rotation A.—Alfalfa five years, potatoes, *wheat,* flax.

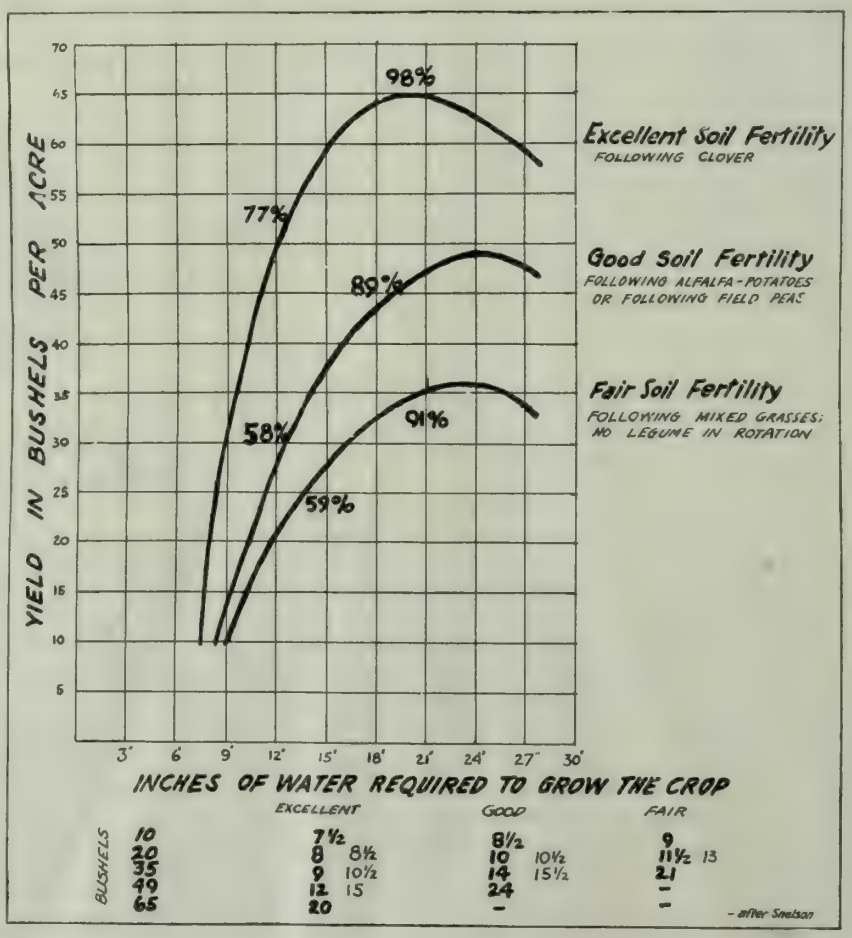
Rotation E.—Peas, *wheat,* oats, barley.

Rotation C.—Mixed hay grasses three years, potatoes, barley, *wheat.*

The accompanying diagram shows that under excellent conditions of soil fertility such as obtained (Rotation A) following the plowing under of a two-year stand of red clover, a maximum yield of 65 bushels per acre was obtained with a total depth of water used (precipitation through growing season plus irrigation applied plus stored soil water used) of 20 inches.

Under good conditions of soil fertility such as obtained following alfalfa-potatoes (Rotation A) or peas (Rotation E) a maximum yield of 49 bushels per acre was obtained with a total depth of water used of 24 inches.

Under fair conditions of soil fertility, such as obtained following grass-potatoes-barley (Rotation C) a maximum of 36 bushels per acre was obtained with a total depth of water used of 24 inches.



THE TABLE shown under the diagram gives in heavy-type figures the inches in depth of water required to produce given yields of wheat under excellent, good, and fair conditions of soil fertility when the water was applied in irrigations of four inches depth each. The light-type figures give the depth required when the water was applied in six-inch irrigations.

A yield of 35 bushels per acre required 21 inches of waer under fair conditions of soil fertility but only 9 inches of water under excellent conditions of fertility.

The figures on the curves give, opposite the use of 12 inches and 18 inches of water, the percentage of maximum yield obtained by the use of these depths. Twelve inches of water produced 58 per cent of the maximum yield on good fertility and 77 per cent on excellent. Eighteen inches produced 89 per cent on good fertility and 98 per cent on excellent.

This information will be of value to growers of wheat under irrigation, who are sometimes in doubt as to how much of the optimum amount of water they can use with economy. There would be no question in the irrigator's mind as to whether, having supplied the crop on excellent soil with 12 inches of water, it would pay to ap-

ply 6 inches more, for in so doing he would obtain an additional yield of 15 bushels per acre at the cost of one irrigation. On the other hand, having supplied the crop on the fair soil with 18 inches of water to obtain 33 bushels per acre it would be a question of weighing the cost of an additional irrigation against the three additional bushels to be obtained.

This diagram emphasizes the necessity of maintaining a high standard of soil fertility where grain is grown upon high priced irrigated lands. One and one-half acre-feet of water produces 3.6 bushels per acre-inch in the excellent soil and but 1.8 inches per acre-inch in the fair soil.

The soil at the Brooks Station is silt-loam. The mean temperature and precipitation for the growing season, April to December, is 56.6° F. and 8.32 inches (1915 to 1925).

Are Your Tools Right?

The practical irrigation farmer needs a few essential tools, in order to work to good advantage, points out a writer in THE HIGHWAY MAGAZINE. The executive and adviser who is interested in improving the efficiency of the water user should see that he is provided with these implements. Along the essential items is a land level for finishing off all fields before seeding. This can be simply made of plank two inches thick by eight or ten inches wide, 16 to 20 feet long, and altogether eight feet wide, for four or six horses. Pulled across the field, it will fill all dead furrows, will level back furrows, and fill all voids. This machine will also do considerable general smoothing and clod crushing.

Next a ditcher of some kind is needed. A common 18-inch lister or double plow makes a very good lateral. One or two furrows with a common plow, and then a trip through with a go-devil or a log will do the work. A good ditcher can be made from two, a right and left, 14-inch walking plows bolted together, and pulled by four horses.

There are various systems of dams, the farmer should decide which is best suited for his use. A plan which has been found very good, is to make provision for a number of adjustable metal dams when making the ditches. This prevents loss of water and time in the rush hours of irrigation. A good point, not always remembered, is to place the dams in the high places. Avoid the low spots. They will take care of themselves when it comes to getting their share of the water. Keep the laterals clean. A clean lateral means water saved, and on an irrigated farm, water

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Samuel Fortier's well-known work "Use of Water in Irrigation," first issued in 1915, and revised and printed in the second edition in 1916, has been just issued in the third edition, in considerably revised and amplified form. Dr. Fortier's book has been recognized as a standard work for the guidance of the application of irrigation water since its first appearance, and its modernized version will undoubtedly enable it to hold its place of popularity on the reference shelf and the executives' desk, and in the farmer's library and the class-room.

In the preface to the third edition, Dr. Fortier says:

"During the decade that has elapsed since the first edition of this work was published, the practice of irrigation has been much improved, the farmers' part in irrigation development better understood and appreciated, and the fundamental principles of irrigation farming more fully elucidated.

"To record these changes aright, and to present in summarized form the knowledge that has been gained on different branches of the subject since 1915, it has been necessary to add a number of new articles and to rewrite and enlarge much of what has appeared in the earlier editions.

"The author hopes that this latest effort on his part and of those who have been associated with him will bear fruit and that this revised and enlarged edition will continue to be a safe guide to irrigation practice in this country."

In the revision, Dr. Fortier has added a large amount of thoroughly up-to-date material, embodying the latest investigations in many departments of the broad subject of the use of water. Only the discussions of the broad principles of irrigation have been left unrevised; the statistical matter has been entirely worked over, taking the latest census enumeration as its basis in most cases, while the references to modern practices and present-day knowledge is written entirely from the point of view of 1925.

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Keeping Pace With Irrigation

(*Continued from Page 23*)

There would be provided by such development irrigated lands for supporting additional people as well as the better supporting of those already there. The financing of the work as a whole would be relatively easy and simple from the very fact that the danger of failure is reduced to the minimum and the land can be put to work immediately when additional water is available.

This is only one example of many that could be cited, showing the possibilities of this line of development. There are instances where a little additional capital would provide for the enlargement of existing reservoirs that would bring the present irrigated lands up to full production. In other localities this additional capital might be used in replacing temporary structures with permanent ones, thereby reducing the annual operation and maintenance costs and so on throughout the category.

In one district in Utah, water is raised to a height of 325 feet by means of pumps for irrigation. At the north end of this district on the same side of the hill there is flowing down from the mountains above a stream of water which is used for the irrigation of lands lying for the most part below those lands covered by the pumping plant. In other words, the water in this stream is flowing down through at least 300 or more feet in elevation before being raised by means of the pumps. An exchange of water in this case would make both projects feasible and economically safe. Such cases as this would require, undoubtedly, the assistance of outside aid in bringing about the desired transfer of water rights.

Such work as this kind of development coupled with our efforts to help solve the individual irrigation problems, and coupled with our endeavor to coordinate the investigational reclamation work of the western states in those problems of general and basic value, offers sufficient opportunity for the future efforts of this division.

Our division is not a large one and funds at our disposal are quite limited. We feel, however, that this division has returned to the people in real value many fold the funds expended. Our endeavor in the future will be as it has been in the past to be of more and more service in helping solve the every day problems of the farmers and rural districts that are making their homes upon irrigated lands, that their lot in life may be more prosperous and contented.

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WITH THE WATER COMPANIES

Of Interest Expressly to Water Works Engineers, Superintendents and General Managers

STREAM POLLUTION IS A NATIONAL PROBLEM

By NATHAN T. VEATCH, Jr.*

PROTECTION of our streams, and other bodies of water as well, is nothing more or less than the protection of a national resource, in fact, one of our most valuable national resources, since it concerns the all important question of public water supply and therefore, concerns all city dwellers in locations where ground water supplies are not available. Some industries are entirely dependent on reasonably pure stream water and all industries are dependent on water supplies of some nature.

By no means the least important feature of this question is the fact that it is becoming more and more acute each year through the increase in urban population, the increase in the number of municipal sewer systems, the increase in industries which produce objectionable trade wastes and in the rapidly increasing number of cities which are being forced to use surface water to get an adequate supply.

The increase in the urban population of the United States is shown in the following table adopted from the U. S. Census which shows that the urban population of the United States in 1920, exceeded the rural by approximately 3 million, and there is every indication that this excess will continue to increase.

	1900	1910	1920
Population of U. S. (million)	76	92	106
Rural, (million)	46	50	51.5
Urban, (million)	30	42	54.5

There seems to be no available authentic data on the number of sewer systems in the U. S. but, based on experience in the central west, it may be stated that at the present time a town of 2,000 without a municipal sewer system is decided exceptional, and that probably 75 per cent of these systems have been built in the past 20 years. It is therefore reasonable to assume that within 20 years, practically all towns of 1,000 and over will be served with sewers. Similarly, there seems to be no available authentic data in regard to the change of municipal ground water supplies over the country to surface water, but again judging from experience in the central west where numerous cities have had to make this change, through inadequacy of ground water supplies, this factor is important.

NATHAN T. VEATCH

THE MANUAL of the American Waterworks Association estimates the number of water works in the United States as 9,850 in 1924, of which 36 per cent are surface supplies. In view of the fact that practically all of the cities in excess of 30,000 are included in the 36 per cent it is probably safe to say that 75 per cent of the urban population of the United States is served with surface water from streams, lakes, or artificial reservoirs, and that approximately half of this number, or 20 million persons, are served from water supplies taken from streams which are subject to pollution from municipal sewage, trade waste, or drainage from barn yards or feed lots.

The present standard of purity as set forth by the International Joint Commission in 1913, in an extensive investigation of boundary waters, considered as safe for surface waters which are to be purified by modern plants, consisting of settling and coagulating basins, filters and sterilizing equipment, demands that "the raw water shall not have objectionable odor, color, or taste, and shall not contain more than 500 bacteria of the intestinal type (B Coli) per cubic centimeter."

Practice has shown that the above is not a bad standard to shoot at although satisfactory water is produced at many places where this standard is often exceeded, but the fact remains that the use of such water is dangerous and puts too heavy a load on the purification plant. This extra burden surely should fall on those agencies causing the pollution, which calls for purification of sewage and trade wastes where pollutions exceed a safe limit. As a matter of fact some of the streams of the country are called upon to furnish water for municipal water supplies at a rate which in the aggregate exceeds the flow of the stream at times. This was true of the Verdegris River in Kansas in the fall of 1917, when the aggregate amount of water used by Kansas municipalities along its course, was approximately three times its flow at the Oklahoma State line.

THE CHIEF source of stream pollution is undoubtedly municipal sanitary sewage which may be made up of anything, but which is reasonably uniform except as to trade wastes.

For the study of stream pollution the character of sewage is customarily reported as solids both in suspension and in solution, as organic matter in the form of total nitrogen and "Oxygen Consumed," and as "Biochemical" or "Biological Oxygen Demand" which last is a measure of the oxygen required to mineralize the organic matter in the sewage.

*A paper presented to the National Drainage Congress at its 1926 annual meeting, Oklahoma City, Okla.

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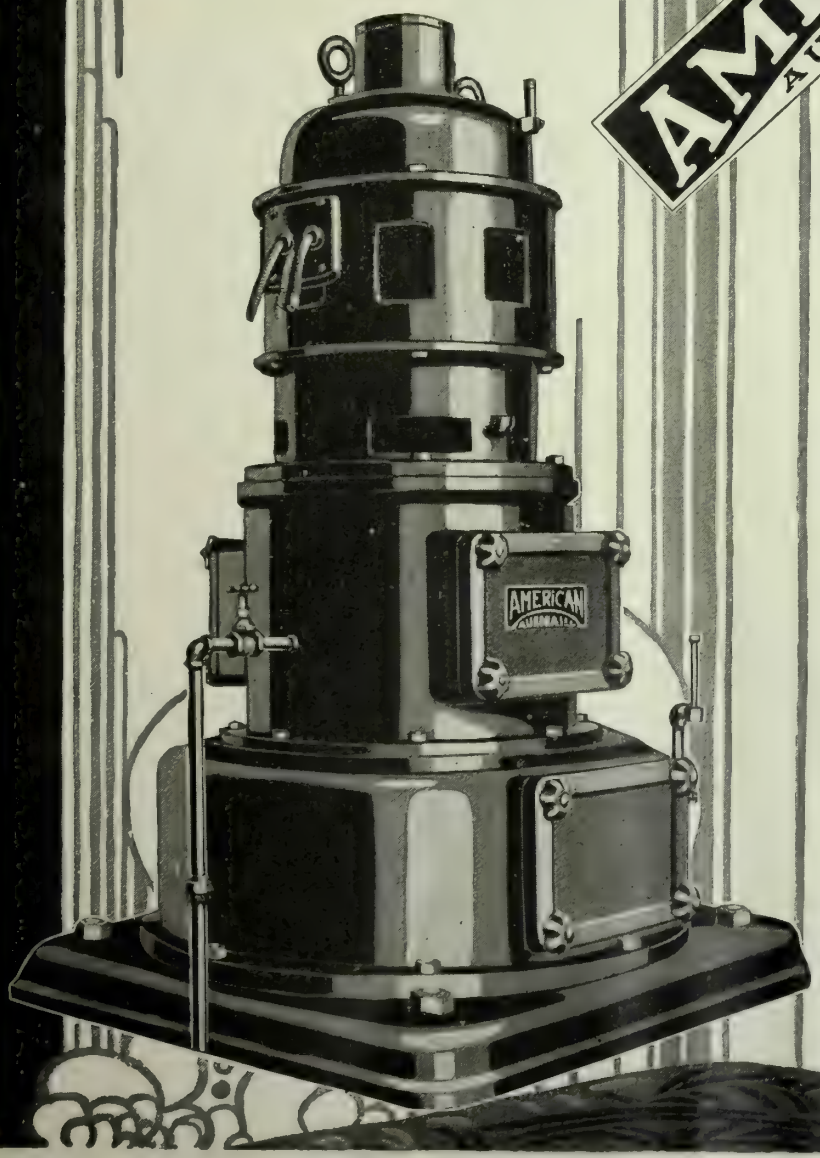

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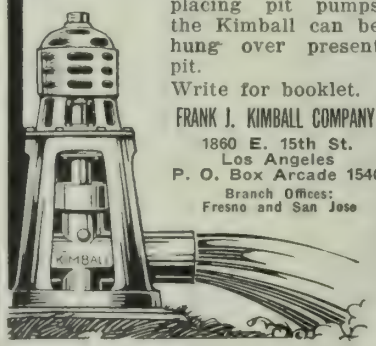

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*Estimated average amounts of Total Nitrogen and Oxeygen consumed contained in various industrial wastes, per unit of product, raw material or labor, with approximate equivalents in domestic sewage.**

Nature of Waste	Unit of Measurement	Grams per Unit		Approximate No. persons required to produce the equivalent of this waste in domestic sewage.
		Total Nitrogen	Oxygen Consumed	
Slaughter house	1 animal	238.6	183.7	7
Pork packing	1 "	243.1	307.5	9
General packing	1 "	171.5	344.2	8
Glue making	1 employee	3,193.3	4,427.1	102
Soap making	1 "	27.2	2,084.7	33
Wool scouring	100 lbs. raw material	340.2	1,551.3	30
Wool cloth dye and scour	100 lbs. raw material	704.4	7,112.4	124
Cotton cloth, bleach and dye	100 lbs. raw material	1,111.3	6,159.9	115
Paper-sulphate pulp	1 ton pulp product	1,315.4	647,741.0	13,000
General paper mill	1 ton paper product	19,504.8	29,937.6	780
Straw Board	1 ton product	5,715.4	151,502.4	2,500
Tanning	1 skin	163.3	1,261.0	22
Creamery**	10 lbs. butter fat	.90	7.90	14
Corn Products** refining	100 bushels			500

*Adopted from Table 46. United States Public Health Service Bulletin No. 143.
**Estimated from a number of analyses.

Bulletin No. 143 of the U. S. Public Health Service states that average domestic combined sewage without major trade waste will contain the following constituents in grams per capita per day.

Total Solids, 439; Dissolved Solids, 330; Suspended Solids, 109; Total nitrogen, 11.4; Oxygen consumed, 51.5; Biological oxygen demand, 100.

For a city of 10,000 persons, therefore, 1,000,000 grams or 2,204 lbs. of oxygen will be required for sanitary sewage.

Trade wastes are of course more variable and require special study in each instance. They may range from sawdust which has practically no effect on the water, to wastes from coal tar product work which cause objectionable tastes in waters in several million dilutions of pure water.

Several specific wastes have been studied and found to contain total nitrogen and oxygen consumed as shown in the table on Page 36, which also gives the approximate equivalent of the waste in terms of sanitary sewage.

Generally speaking, therefore, it is possible to convert the pollution by trade wastes into its equivalent in sanitary sewage and from this figure to determine the required dilution or treatment necessary to prevent pollution. The dissolved oxygen in stream water will vary from approximately 14 p.p.m. at 35 deg. F. to approximately 9 p.p.m. at 70 Deg. F. provided the stream is not already polluted and therefore less nuisance is caused by a given amount of sewage in equal amounts of water in winter than in summer.

FROM the above stated figure of 2,204 lbs. which represents the daily amount of oxygen required to mineralize the sewage from 10,000 persons, and assuming that 5 p.p.m. of oxygen may be given up by the stream at any time without causing serious nuisance or damage to fish life, it may be estimated that a flow of 80 cubic feet per second or 8 cubic feet per second per 1,000 population will be ample for dilution. Such calculations are misleading however, and cannot be generally applied since so much depends on the local condition of the stream. In the past some authorities have stated that a flow of 4 cubic feet per capita is ample while recently the Royal Commission in England has recommended a dilution of 27.8 cubic feet per second per 1,000 persons.

Self purification of streams is a factor in this problem, but is badly misunderstood. For instance, we have often heard the statement that the Missouri River purifies itself in 7 miles, but this may or may not be the case. Self purification is a factor of time, since certain chemical and biological changes must take place and therefore, the velocity of the stream, its turbidity, turbulance and other factors must be considered.

Mr. Langdon Pearse states that the Illinois River on one test absorbed 205,000 lbs. of oxygen from the air while flowing a distance of 65 miles, which fact merely shows that oxygen for self-purification can and does come from the air, but this figure cannot be considered for general application, since it represents a certain set of conditions which may or

may not be duplicated elsewhere.

Ohio River pollution studies by the United States Public Health service show that the time of flow from Pittsburgh to the Mississippi River may be anything from 14 days to 129 days, depending on the river stages, which fact again emphasizes the point that each instance of pollution is a problem in itself.

This is only an outline of some of the features of the stream pollution problem, but serves to show that streams have a definite capacity for biological disposal of sewage and trade waste and that if the municipalities, and other sewage or trade waste contributors along the stream, control the amount of pollution which they contribute, by properly designed and operated sewage disposal plants, the streams can be kept in good condition, not only as regards nuisance but as regards water supply, fish life and other features.

The solution of this problem is obvious and calls for

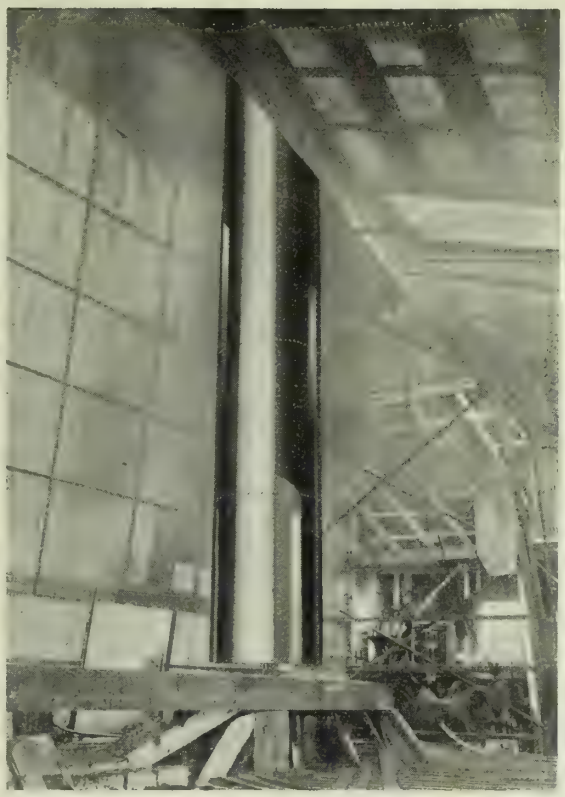
1. Treatment of sewage and trade wastes at their source, to an extent to be determined in each individual case.
2. Maintenance and careful operation of sewage systems and disposal plants.
3. Purification of water at intakes of water supplies, to the extent necessary for safety.
4. Careful operation of water purification plants.

This requires the determination of the extent of purification needed at both ends of the line and for this information we must rely upon information gotten by the Government and State Health Authorities, which are doing immensely valuable work along this line, and deserve better support from the public than they have received in the past.

Customer's Deposit on Disputed Bill Protects Service

The California Railroad Commission has found that the Susanville Water Company, operating in the town of Susanville, Lassen county, was in error in disconnecting the service to J. C. Brokaw, a consumer, to enforce payment of a disputed bill for service, when the latter had made a deposit of funds with the Railroad Commission pending the adjustment of the disputed bill. The Commission directed the utility to revise its charges to Brokaw, and ordered another consumer, who was sharing service on the same line, to pay one-half the disputed bill.

The Commission, in its decision in this proceedings, which, although involving but a small amount, was made the basis for a formal proceeding, re-emphasized the principle that utilities must not discontinue service to enforce collections where consumers have deposited the amount of the disputed bill with the Railroad Commission for adjudication.



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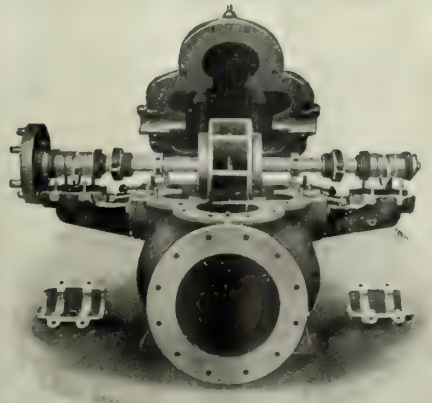

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WHO'S *WHO* AND WHO'S *WHERE*

IN THE WORLD OF HYDRAULICS

Personal Notes and Impersonal Observations About Men You Know

Oro McDermith, engineer of the Kittitas Reclamation district, has returned to his office from Washington, D. C., where he represented his district in congressional and departmental hearings.

Eugene P. Hyatt of Lakeside, California, has been appointed by the governor of the state to succeed Dr. L. R. Knorr, resigned, as a member of the board of directors of the recently organized Lakeside Irrigation District.

John Morrow, member of Congress from New Mexico, has been named a member of the House Committee on Irrigation and Reclamation. The appointment is regarded as a matter of congratulation to Mr. Morrow on account of the great and growing importance of irrigation and reclamation in his state.

A. T. Straton, soil expert of the U. S. Reclamation Bureau, is in Yakima, Washington, conducting a soil survey of the Yakima-Benton division of the Yakima reclamation project, working with the co-operation of J. L. Lytel, project manager. The Moxee and Kennewick divisions are to be surveyed as soon as the present work is completed.

William J. Carr, Los Angeles attorney who has been prominent in the debate of the Colorado River problem, has gone to Washington to lend his assistance in possible changes that may be made in the terms of the Boulder Canyon (Swing Johnson) Bill. He will act as a representative of the interests of the city of Pasadena and the city of Glendale.

City officials and engineers of San Diego, California, recently made an inspection tour of alternative sites proposed for the first unit of the city's contemplated water supply improvements. City Manager Fred Rhodes, accompanied by Thornton Mills, hydraulic engineer for the water department, J. W. Williams, consulting engineer, Shelly J. Higgins, city attorney, and Councilman Virgil Bruschi, inspected the proposed route for a pipe-line from Lake Hodges to the city by way of San Pasqual, and the alternative routes via Sutherland and San Vicente.

Dr. Elwood Mead, National Commissioner of Reclamation, is expected to attend the meeting to be held June 24-26 at Yakima, Washington, when the Washington state chamber of commerce will be in session for three days. The meeting is expected to give a good deal of attention to reclamation problems, notably that of state aid, and Dr. Mead will be asked to give a statement of the position of the Reclamation Bureau in the matter.

Pima County, Arizona, has evidenced its interest in water conservation by the appointment of a representative committee to conduct an investigation of the flood waters and other water resources of the county. The chairman of the committee is Fred Ronstadt, who will have the co-operation of C. B. Brown, county agent, in the water studies. The committee was named at a mass meeting of Pima County farmers.

Governor Richardson of California has appointed W. H. West as a director of the La Mesa, Lemon Grove and Spring Valley irrigation district, to succeed J. H. Halley, on the recommendation of the directors of the district. Mr. Halley has been acting as head of the Lemon Grove Mutual Water Company, which is one of the properties to be taken over by the district in its expansion program. When the consolidation contemplated becomes effective Mr. Halley expects to enter the employ of the district to continue his work.

Walker R. Young, construction engineer of the U. S. Bureau of Reclamation, has been named to have charge of the construction of the Kittitas high line canal, the Washington project which will involve an estimated cost of $7,500,000. Mr. Young has had a varied experience with the Bureau, having been connected with important construction work in various parts of the west. His present assignment is to investigations on the Sacramento River in California. It is understood that R. W. Williams, who has been in charge of the Ellensburg office of the Yakima project, will be Mr. Young's assistant.

The policy of the state government of Washington toward reclamation and irrigation was discussed with members of the state reclamation board during March by Mark Moulton, state representative from Kennewick, and F. A. Kern, secretary of the Kittitas reclamation district and newly elected president of the Washington Irrigation Institute. Thirty members of the state legislature and several national congressmen attended the meeting and heard the irrigation men advocate a thorough investigation of all the facts, in order that the next legislature might decide what the state's attitude should be toward continuing the policy of state participation in reclamation.

A delegation of prominent state officials and business men of Idaho were guests of Los Angeles late in March, coming as an official Chamber of Commerce mission in the interest of trade expansion and business co-operation between the northwest and the southwest. The delegation was headed by Governor C. C. Moore, and numbered among its members several well known reclamationists, including Warren G. Swendsen, state Commissioner of Reclamation, and R. E. Shepard, of Jerome, president of the Idaho State Chamber of Commerce.

The personnel of the delegation, in addition to Governor Moore, was: W. G. Swendson, Commissioner of Reclamation; A. H. Connor, Attorney-General; Q. R. B. Kjosness, Commissioner of Agriculture; R. E. Shepherd, president of the State Chamber of Commerce; E. W. Porter, Commissioner of Finance; R. E. Thomas, State Game Warden; J. A. Harader, secretary of the State Chamber of Commerce; O. O. Haga, president of the Boise Chamber of Commerce; J. L. Priest, general agent, Union Pacific Railway system of Boise; F. F. Johnson, president Boise City National Bank; C. J. Sinsel, Boise fruit dealer; J. C. Palumbo; fruit dealer at Pyatt; R. E. Beach, Lewiston merchant; J. C. Jacobsen, C. J. Carlson and L. Wilder, potato growers, Idaho Falls; C. E. Arney, Union Pacific Railway.

Mokelumne River Project Is Making Good Progress

The great Mokelumne River project, eventually to cost $39,000,000, and to supply communities on the eastern side of San Francisco bay with water from the high Sierras transported across the San Joaquin Valley, is making rapid progress toward completion, according to a report rendered by Arthur P. Davis, chief engineer and general manager of the East Bay Municipal Utility District, to the board of directors of that organization during March.

Mr. Davis reported on the various phases of the work as follows:

"Smith Brothers, Inc., contractors for the Lafayette tunnel, have excavated 233 feet of tunnel during the past week, making a total to date of 4278 feet, which is 28.2 per cent of the entire length. A total of 144 feet of invert was poured in the tunnel heading from the west portal. The excavation of the tunnel has been carried on in four of the six headings during the past week and the organization has been enlarged to permit of prosecuting the work at five headings from now on.

"T. E. Connolly, contractor for the Walnut Creek tunnel, has excavated during the past week 72 feet of tunnel, making a total of 2109 feet excavated, or 99.4 per cent of the whole. The tunnel is being trimmed up to shape and concreting will soon start.

"Twohy Brothers Company has erected fifty piers for supporting steel pipe, fifteen are under construction, in a total of 186 piers required. Six sections of pipe have been finished and hauled to the trench and laying of the pipe was begun March 11.

"The testing of plates at Eastern mills and shops has been continued, and at the close of March 12 reports on this work showed that 7006 plates had passed inspection at the mills; 5380 had passed inspection at the shops; 3838 had been shipped from Newport News to Oakland and had been delivered to the Steel Tank and Pipe Company's plant. At the Berkeley shops of the plates received 275 had been rolled and from these 124 pipe sections had been tack welded; 103 had been machine welded; 36 had been tested; 19 had been dipped; 9 had been wrapped and 6 had been sent to the field for installation.

"The water stored in the reservoirs of the East Bay Water Company on March 12 was 5,332,600,000 gallons. The production from the wells during January and February, 1925, was 1,086,800,000 gallons, and for the same months of 1926 was 660,333,000, showing a decreased production from the wells during January and February of 426,500,000 gallons."

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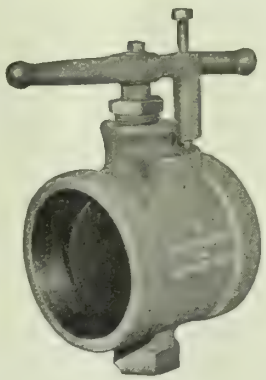

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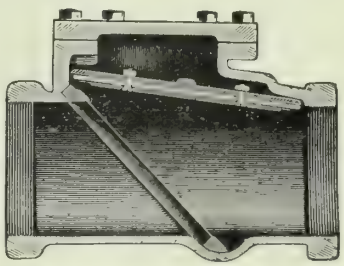

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RECLAMATION

"WON'T WORK, MR. WORK," SAYS SENATOR McNARY

SENATOR CHARLES L. McNARY, of Oregon, has declined to accept a proposal advanced by Secretary of the Interior Hubert Work, providing for a joint committee to work out a scheme of future construction of new reclamation projects.

Secretary Work, in suggesting the plan to the senator, submitted that some scheme seemed to be necessary to keep expenditures of reclamation funds within safe limits during the next ten years.

Senator McNary based his disapproval of the suggestion on the ground that he did not deem the course of action wise because it would divide responsibility and would result in decentralizing authority in the selection of new projects when centralization of authority is needed to meet the excessive demands on the Reclamation fund. The Senator's letter in full follows:

"Before me I have your recent letter stating that the demands upon the reclamation fund for the construction of new projects far exceed the sum that will be available for a considerable period of time and suggesting that I 'communicate with the Senate and House and request that a special joint committee be appointed, consisting of the Chairmen of the Senate and House Committees on Irrigation and Reclamation, the Chairmen of the Committees on Appropriations of the Senate and House, the Director of the Bureau of the Budget, and the Secretary of the Interior, to work out a scheme of future construction for the purpose of keeping within safe limits the amount of expenditures for the next ten years.'

"You ask me to take this action in the event it appears to be judicious. I regret, Mr. Secretary, to advise you that I do not believe this course of action wise. It would simply divide responsibility now wholly residing in you into as many human units as six is divisible by one, thereby passing the ultimate responsibility around in a circle without a beginning or an end. I feel that such a plan would work for decentralization when centralization of authority is greatly needed to meet the excessive demands on the reclamation fund, particularly when the only reservoir of information of the worthiness of the proposed projects is found in your department, the Bureau of Reclamation, and your chosen soil experts, engineers and economists.

"The laws provide that you may examine into the merits of projects pressing for development and if convinced of their feasibility, transmit your approval with estimates of costs to the Director of the Bureau of Budget, who, if satisfied the costs do not conflict with the economy program, will submit the estimates to the President. Meeting with the President's approval, the estimates are transmitted to Congress for appropriate action.

"The procedure here briefly sketched affords sufficient safeguards against wasting any portion of the Reclamation fund on infeasible projects.

"The present plan and practice of committing to the Secretary of the Interior the responsibility of initiating the consideration of new projects and their construction, in my judgment, should not be substituted by your proposal, however hopeful you may be as to its excellence and desirability.

"In disapproving of your proposal, I must not be understood as being desirous of retreating from any responsibility placed upon me as Chairman of the Senate Committee on Irrigation and Reclamation, as in such a capacity at all times you may be assured of my anxiety to cooperate with you in carrying out successfully this great work of development through reclamation."

SECRETARY WORK'S proposal followed the revelation that the present and immediate demands for reclamation construction are far in excess of any anticipated revenues, making a careful selection necessary among the projects being urged for approval.

Citing that old projects will require $60,000,000 to complete and new projects now pending before Congress will require $60,000,000 more or less, to build, while 15 additional projects have been urged on the Interior Department this winter costing about $40,000,000, the Secretary stated this program of expenditure was considerably in excess of the probable income of the Reclamation fund.

"The average annual receipts of the Reclamation fund applied to construction," he continued, "for the past five years have been approximately $8,500,000. There is no prospect of the annual income being increased during the coming five years. Excluding moneys advanced by private interests to aid in the construction of the American Falls Reservoir in Idaho, the total for last year fell $2,500,000 below the previous year."

The Secretary pointed out that with this threatened diminution in the annual revenues every increase in the number of projects will mean reduction in the amount allotted to each individual project and that there is also the danger, unless a definite authoritative building program is soon adopted, that the funds will be distributed over so many localities that work will be prolonged, costs increased and dissatisfaction engendered regarding delayed development in the localities to be benefited.

In part, his letter read:

"During the present Congress little or no consideration has been given to this financial situation. The Bureau is being continually urged to recommend projects not included in the tentative program. The result is the total of these recommended new projects, which have been introduced in Congress, and for which estimates have been made, aggregates about $33,000,000. If others for which there are no estimates are included, the total will be somewhere between $35,000,000 and $40,000,000. A number of these projects have great merit and should be included in a construction program if there were sufficient funds. With a threatened diminution in the annual revenues, every increase in the number of projects means reducing the amount allotted to an individual one. And there is also danger, if a definite and authoritative program is not soon adopted, that the funds will be distributed over so many localities that the work will be greatly prolonged, its cost increased and dissatisfaction engendered regarding slowness of develop-

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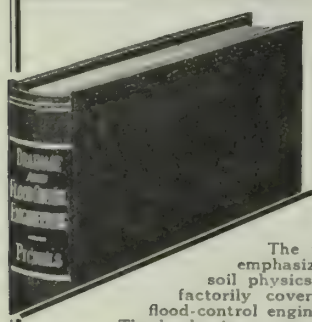

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ment in the localities which are to be benefited.

"There is a widespread belief that the selection of new projects is largely governed by personal considerations. It needs to be made clear that this is not true. In addition, there is much to be gained by a co-ordinated and carefully thought out program of development, the preparation of which would be participated in by Congress, this Department and the Bureau of the Budget. Such a program, when adopted, should be adhered to until changed by Congressional authority."

PROPOSED new projects and divisions of old projects that are now being asked for number 25 and are located in ten Western States. Oregon leads the list asking for 6 new projects, their total estimated cost amounting to $26,800,000. Wyoming is second with 2 new projects at an estimated cost of $16,060,000 while Washington is third asking for 2 new projects and an extension of an old project, their total estimated cost being $13,800,000. Fourth on the list is Idaho asking for 3 new projects at an estimated cost of $12,430,000.

A list of the States with the number of Federal irrigation projects asked for and their total estimated costs includes: California, three new projects costing $9,771,060; Utah, extension of one old project costing $11,000,000; Nevada, extension of one old project costing $6,291,000; Montana, one new project and extension of one old project at total cost of $4,900,000; Texas, one new project costing $3,000,000; and New Mexico, one new project costing $2,237,000. In addition, three new projects are being asked for in Montana, New Mexico, and Texas for which no estimates of cost have been made.

A list of the new reclamation projects and divisions of old projects asked for with their estimated costs follows:

Project	Estimated Cost
California	
Butte Creek	$ 5,368,880
Deep Creek	3,151,180
Orland-Stony Gorge	1,251,000
	$ 9,771,060
Idaho	
Gooding Project	6,000,000
Hillcrest	865,000
Black Canyon	4,565,000
Washington County Irrigation District	1,000,000
	$12,430,000
Montana	
Lonesome Prarie, No estimate	
Sun River (Beaver Creek)	4,900,000
Nevada	
Spanish Springs	6,291,000
New Mexico	
Alamogordo (Carlsbad)	2,237,000
Rio Grande (Albuquerque)	No estimate

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Oregon	
Westland Irrigation District	600,000
Stanfield Irrigation District	300,000
Stanfield Extension	300,000
Baker	4,000,000
Owyhee	18,000,000
Vale	3,600,000
	$26,800,000
Texas	
Trinity River, No estimate	
Red Bluff	3,000,000
Utah	
Salt Lake Basin	11,000,000
Washington	
Methow-Okanogan	5,000,000
Kittitas-Yakima	8,800,000
	$13,800,000
Wyoming	
Casper-Alcova	13,500,000
Saratoga	2,560,000
	$16,060,000

President Designates April 18-24 American Forest Week

President Calvin Coolidge has issued a proclamation designating April 18 to 24 as American Forest Week, during which the attention of the nation shall be centered on some of the vital problems of forest conservation and renewal. Canada has joined with the United States in the designation of this week for the purpose, and organizations of both countries interested in forest problems are making special efforts to arouse public interest.

In the United States the Forest Service, the Biological Survey and the Bureau of Plant Industry, as national agencies, will co-operate with state organizations in the observance of the week.

The president, in proclaiming the special week for observance, said:

"Although our national progress in forestry has been well begun, much remains to be done through both concerted and individual effort. We must stamp out the forest fires which still annually sweep many wooded areas, destroying timber the Nation can ill afford to lose and killing young growth needed to constitute the forests of the future. Forest fires, caused largely by human indifference or carelessness, are the greatest single obstacle to reforestation and effective forest management.

"We must encourage and extend methods of timber cutting which perpetuate the forest while harvesting its products. We must plant trees in abundance on idle land where they can profitably be grown. We must examine taxation practices that may form economic barriers to timber culture. We must encourage the extension of forest ownership on the part of municipalities, counties, States, and the Federal Government. And we must take common counsel in public meetings to the end that the forestry problems of each region may be well considered and adequately met."

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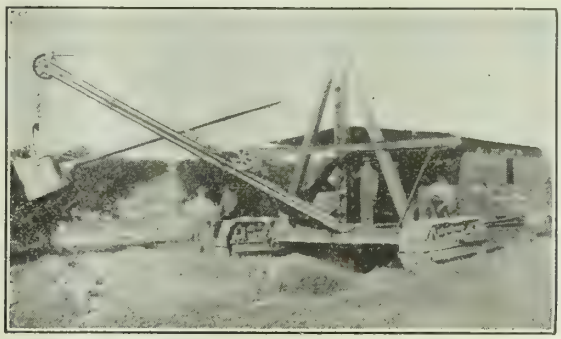

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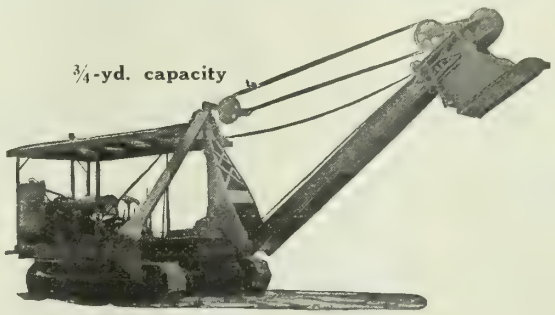

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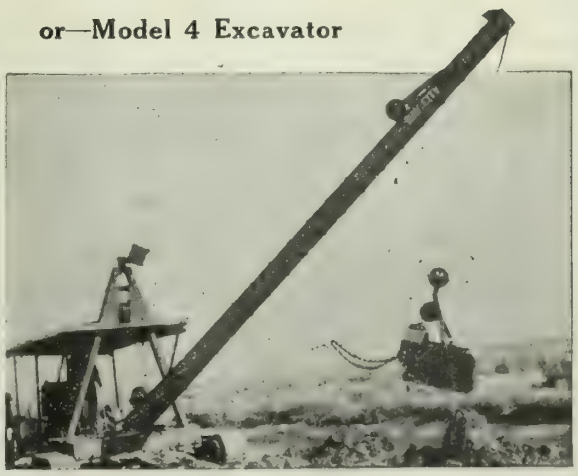

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LEGAL *and* JUDICIAL

BY HANKINS & HANKINS

Bond Issue Not a Mortgage

The bond issue of an irrigation district is not a mortgage.

In the case of Kollock v. Barnard, 242 Pac. 847, (Jan. 22, 1926), the Supreme Court of Oregon held that the proper remedy of the bond holders of an irrigation district, to enforce the payment of their bonds, was by the way of a writ of mandamus directed to the directors of the district, requiring the levy of the annual assessment. That another remedy providing for the taking of possession of the irrigation works upon default, under the Oregon laws, was merely cumulative.

The bond issue of an irrigation district is not a mortgage. There is nothing in the statute which gives the bond holder a lien upon the irrigable land included within the district. The primary and only source of the payment of bonds is the annual assessments levied and assessed by the board of directors, and unless the holders of bonds can, by mandamus or otherwise, compel such annual levy, they are without an adequate remedy.

The defendants raised the point that there were sufficient delinquent assessments already levied, which, if collected, would pay the amount due on the books. On this point the court stated: "As we understand the statute, instead of delinquent assessments being available as an asset at the time of making the annual assessment, it is necessary to make provision for such delinquencies in computing the amount to be raised."

May a District Employ Legislative Agents?

Is an irrigation district entitled to employ legislative agents?

A case of great importance to irrigation districts of California has arisen in the Superior Court of Imperial County in an action entitled Crawford vs. Imperial Irrigation District, et al.

In its work of getting favorable action by Congress on the Boulder Canyon Project (Swing-Johnson Bill), the district employed B. F. Fly to appear before Congress and the various Congressional committees to present the case of the Irrigation District. A suit was filed by a land owner to prevent the payment of compensation to Fly.

The case was submitted to the Superior Court on the stipulated facts.

No question of improper means of influencing legislation was involved but the Superior Court considered that an irrigation district had no legal right or authority to expend its money for such purposes, although such purpose was laudable and necessary, and gave judgment against the district.

The irrigation district has taken an appeal to the Supreme Court and the decision of this tribunal should be rendered within the next six months.

The Irrigation Districts Association of California have decided to file a brief as "Amicus Curiae" so as to present the views of all irrigation districts of the state as to their right to expend money for similar purposes.

Liability of Trustees for Negligence

Liability of Levee District trustees for negligence at issue in California case.

In the case of Moore v. Burton, 242 Pac. 902, (.....Cal. App.....) a demurrer was sustained to a complaint alleging damages for negligence on the part of the trustees of the Palo Verde levee district in failing to repair a broken levee. Plaintiff refuses to amend and judgment is given in favor of the trustees.

On appeal the court held that it fairly appearing from the allegations of the complaint that by the acts described and alleged to have been negligent, a dangerous condition was created; that neither the danger nor the injury complained of could have been avoided by the exercise of ordinary care by appellant; and that by no act or omission on his part was the damage caused or contributed to, the complaint was sufficient.

The requirement of the statute that it must appear that the injury was sustained "while the public work or property was being carefully used" was not applicable, as it appeared that the levee work described, unlike roads or bridges, was not of a character permitting its use by appellant.

Judges' Eligibility to Try District Cases

Supreme Court rules on disqualification of superior judges to try irrigation district cases.

An interpretation of the effect of the amendment to Section 170 of the Code of Civil Procedure of California in 1925 by the elimination of paragraph 5 is given by the Supreme Court of California in the case of Hall v. Superior Court of Imperial County, Imperial Irrigation District, et al., Vol———, Page———, California Decision (March 31, 1926). This decision reversed the judgment of the District Court of Appeals in the same case (46 Cal. App. Dec. 908).

The question arose over the right of certain judges owning lands in the Imperial Irrigation District to hear a case involving damages and injunction against the district. A writ of prohibition is asked based both on Sudvision 1 and 5 of Section 170 C. C. P.

The Court points out that Subdivision 5, which disqualified a judge residing in an irrigation district, irrespective of interests, from hearing a proceeding involving such district, was repealed (1925) subsequent to the commencement of the proceedings but that although previously disqualified such judges are not now so disqualified and could proceed to hear the case were it not for Subdivision 1 of the section.

The Court states "The interest which disqualifies a judge from acting judicially in an action under Section 170, Subdivision 1 of the Code of Civil Procedure, must be a certain, definable, pecuniary or proprietary interest which will be directly affected by the judgment rendered . . . and a judge is disqualified if he is a stockholder in a corporation where the corporation is interested in the property involved in the controversy, although not a formal party to the action. . . . The interest of said judges as land owners within said District was such a direct, proprietary interest as to disqualify them from acting in an action involving the property of said District."

A further ruling is made upon respondent's objection to the form of pro-

*Hankins & Hankins are well known attorneys of San Francisco, California, and are attorneys for the Glenn-Colusa Irrigation District.

ceeding, wherein respondent insists that the property procedure is by appeal and not by prohibition. To this point the Court replies: "Where a judge is disqualified to act in any proceeding, or cause, the disability necessarily enters into all orders and decisions made by him other than those specially excepted and provided for in the Codes and to refuse the writ on the ground that a remedy might be had in another manner, would be to permit the trial to proceed to a final conclusion by the disqualified judge and then set aside the proceedings as void ab initio. No good purpose could be served in permitting a disqualified judge to perform certain acts and thereafter declare them void on the ground that he had no jurisdiction to perform the same.

U. S. Not Bound by State Laws

The United States, in operating a reclamation project under the Reclamation Act, is not required to follow state laws.

In the case of Mower v. Bond, 8 Fed. Rep. (2d series) 518 (U. S. Dist. Court, Idaho), the District Manager in the Boise Reclamation Project gave notice to a land owner who had become delinquent in a drainage assessment, that unless payments were made further delivery of water would be withheld. The assessment not being paid the water was shut off.

The Courts have definitely held the levy of assessments (for drainage) to be for "maintenance" and valid.

Plaintiff's principal contention was that in operating the canal system the government and its agents were subject to the laws of the state, and that under such laws, as construed by the Supreme Court of the State, owners of irrigation works are without authority to refuse delivery of water to users because of their failure to discharge delinquencies. This seems to have become the settled rule of the state.

The Federal Court holds that Congress has the power to fix the terms and conditions under which it will sell or permit the use of water on the project and is not bound to follow the decisions or rulings of the state Courts.

Prescription Includes Rights Necessary to Use

A ditch right of way acquired by prescription includes rights necessary for the use of such ditch.

In the case of Neville v. Loudon Irrigation Canal & Reservoir Co., 242 Pac. Rep. 1002 (Colo. Jan. 18, 1926) the Supreme Court reviews the title of a plaintiff in an irrigation ditch which had been acquired by use for some thirty years. The appellants claim that, since the title was by prescription, the right must be limited in scope and extent to what was actually used.

The Court states: The basic ques-

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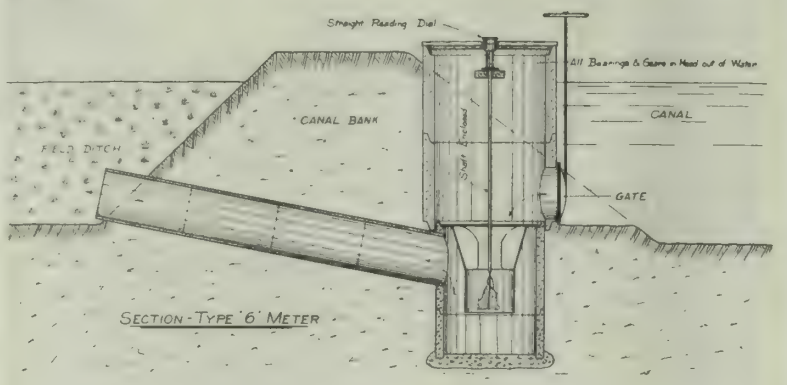

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tion, of course, is, What rights were acquired by prescription? The answer is, "All that is reasonably necessary to the convenient and proper use and maintenance of the ditch." The right of way for a ditch includes the right to maintain it, and that includes repairs, ingress and egress with space therefor as exigency may show.

New Engineering Organization Formed in San Francisco

A group of San Francisco engineers have formed a new engineering society, known as the Society of Engineers. Five hundred members, formerly affiliated with a well known national engineering organization, decided on the move last December when a reapportionment of the funds of the older organization was made by which national headquarters would receive more than local chapters.

The new Society includes representatives of the civil, architectural, mining, mechanical and electrical branches of the engineering profession. Its objects are non-technical in character and devoted to co-operation and the social interests of its members. The officers are: C. H. Tucker, president; Glen B. Ashcroft, vice-president; Albert J. Capron, Secretary. The board of directors consists of W. H. Phelps, C. T. Wiskocil, R. C. Briggs, L. W. Hunt and Louis L. Leury. George E. Tonney is in charge of Public Affairs.

Irrigation Moves Forward in Old Spain

Spain is the latest country to join in the quest for improved water power and hydroelectric development by the nations of both hemispheres. King Alfonso inaugurated the new Spanish irrigation work in Andalusia a few weeks ago by laying the foundation of a great dam near Andujar, where the Jandula empties into the Guadalquivir, the only river in Spain which flows freely at all seasons.

This dam will be 295 feet high and 720 feet long and its estimated cost is $5,000,000, half to be borne by a private company and half by the State. It is expected to furnish 26,000 horse-power of electrical energy as well as to irrigate a large tract of land much needed in that section for cultivation, as indeed is the case almost everywhere in Spain except in Leon and the provinces bordering on the Bay of Biscay. The site of the works is in the wild Sierra Morena, which separates the plateau region of Castile and Estremadura from the Andalusian plain and forms the watershed between the upper Guadiana and the Guadalquivir.

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MODERN Irrigation

Are *You, Too,* Profiting From the Onward March of Reclamation?

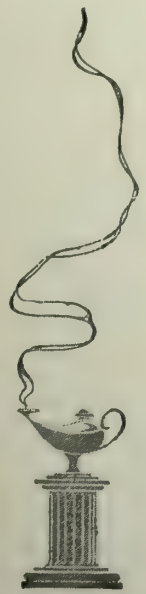
AS RECENTLY announced in these columns, the Republic of Mexico, following the lead of the United States, has passed a "Reclamation Bill" and will expend $30,000,000.00 on some twenty irrigation projects.

The Grecian government, also, taking its cue from the success of such enterprises in America, India, Egypt, Australia and elsewhere, has determined upon a comprehensive program of reclamation and irrigation in Macedonia and will spend approximately $34,000,000.00 on this work.

It is a noteworthy fact that American engineering firms have been placed in charge of both of these undertakings.

Since America (the United States) leads in the manufacture of the most modern irrigation appliances, and auxiliary equipment of every description, the major percentage of these millions will in all probability (aside from labor costs) be spent within the boundaries of the United States.

American-made drag-lines, dredges, and other excavating machinery; trucks, tractors and automobiles; cement, cement re-inforcing and other materials; pipe and pipe fittings; gates and valves; motors and motor controls; meters and other odds and ends that go to make up a fully equipped irrigation project—these will have to be provided for, and the United States is the logical source of supply.



The advertising columns of MODERN IRRIGATION are the logical source of current information regarding such equipment. Engineers and other executives, who do ordering or specifying, will find these columns during 1926 a reliable "Who's Who" of manufacturers selling the hydraulic field. Here the leading, most progressive concerns in every line will be represented.

At this moment, the pages of MODERN IRRIGATION are being examined, and examined carefully, by men whose yearly purchases in *your* line aggregate large sums of money. Long-pull advertising will help you to secure a larger percentage of this annual turnover. The men who buy are reading and studying these advertisements—never doubt it. Consciously, or unconsciously, they are forming their opinions and narrowing down their ultimate choice of equipment. Many actual decisions are made months in advance of the order for the goods.

These projects are but two of the countless many under contemplation—or actual construction—at this time. Nineteen-twenty-six will be a big year in the irrigation and allied hydraulic industries. Millions will be spent for replacements and other millions for new equipment. Are YOU making your proper bid for a share of this business? Are you represented, as an advertiser, in the columns of MODERN IRRIGATION?

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OVERHEAD IRRIGATION

OVERHEAD SPRINKLING HOLDS SPOTLIGHT OF INTEREST

THE increase in acreage under overhead sprinklers throughout the citrus and avocado districts of California during the last twelve months has been several hundred per cent, says Marvin B. Rounds, farm advisor of Los Angeles County in the CITROGRAPH. He goes on to predict that the increase during the next twelve months will, no doubt, be fully as great, judging by the large number of growers who are taking an interest in the subject with a view toward installing overhead irrigation equipment in their orchards. Many are only waiting until it has thoroughly proven itself, as manifested by the success of the systems in those orchards already installed.

Quoting further from Mr. Round's article:

The overhead method is one which has been tried on small plots and in small orchards in several districts of California during the last ten or fifteen years, but it was not until about 1924 that the empetus came, and the acreage under overhead irrigation began to increase very rapidly. Most of the earlier installations were portable or semi-portable; that is, the standards on which the heads were placed were moved about the orchard much like the method practiced in lawn sprinkling, differing, however, in that the standards were of such a height that the sprinklers were above the trees.

MR. ROUNDS describes an interesting installation, that of A. M. Stephens, citrus grower, north of La Verne, who has an overhead irrigating system which has been installed on about 65 acres. This installation has been worked out according to the best known engineering methods and is an example of the necessity of considering the individual orchard or ranch in preparing for this method of irrigation. Mr. Stephens' ranch has a variation in elevation of about 400 feet, the upper end of his planting being actually 380 feet higher than the lower end. The proper distribution of water through a system in an orchard of this kind, allowing for a uniform pressure throughout, is a problem for an engineer. On this property, the matter of pressure and distribution of water has been worked out and tested in such a way that the owner feels he will obtain as uniform distribution as it is possible to obtain under present conditions.

Mr. Stephens has three reservoirs on the property from which he obtains his pressure, one of 200,000 gallons, one of 1,500,000 gallons, and one of 1,250,000 gallons capacity. Center lines, composed of eight-inch pipe, are the leaders, and have five-inch laterals. Each lateral has a shut-off, and each riser for the sprinkler heads also has a shut-off valve. In this way the pressure can be regulated throughout the orchard. Each head receives a pressure of 30 pounds. The compound type of head is used, which is composed of two long arms, on one of which is mounted another whirling spray with shorter arms. As the long arm revolves slowly, the short arm whirling spray, mounted on one of the larger arms, whirls very swiftly as compared to the large arm. This is one type of sprinkler head which is being used in many orchards.

TWO general types of sprinklers are in use: the overhead pipe with openings for the water, and the one attached to an upright which may spray the water on a circular area. The latter type may be divided into revolving heads, and heads which spray the water on a circular area without revolving. Revolving heads may have long arms and supply water to an area covering several trees, or they may be a type having short arms which whirl swiftly and cover one tree. The compound type of sprinkler, already referred to, is perhaps in a class by itself, belonging to the long-arm type. All revolving types of heads obviously cover a circular area and it would be expected that a decrease in the size of the area, with an increase in the number of heads, would increase efficiency in distribution. Just how far one can go in this respect remains to be seen after growers have had experience with the installations already in. Certain it is that this feature of overhead equipment is an important consideration.

Another important consideration is pressure, which, of course, is related to topography of the land, source of water, size of pipes, and in fact to all of the engineering phases of installation of overhead equipment. It is necessary that the system operate a given number of sprinklers so that a sufficient amount of water is delivered in a given time. Individual control of sprinkler heads is necessary in order properly to regulate each one.

It is usually necessary to provide for removal of a part of the riser and the sprinkler head at times, especially when the orchard is fumigated.

Growers have taken an interest in the overhead method for various reasons. Some have thought that labor expense could be reduced; also that water for irrigation could be more economically used. Many have known that they were not getting a proper distribution of water in their orchards through the old furrow method, and others have thought that certain insects and diseases might be controlled by means of this method. Whatever the reasons, we recognize the fact that there are many advantages possible under this system.

Although we do not have the data available for proof, it would be natural to expect to obtain (1) a better distribution of water; (2) a more economical use of water, through a better distribution; (3) probably a greater degree of efficiency in the use of fertilizers applied; (4) a more ideal condition of the entire root feeding zone, making for greater availability of the plant food elements within the soil; (5) the carrying of surface nitrates down to the root feeding zone of the soil; (6) the saving of labor; (7) a small amount of water for use every few days during the fall, promoting a better stand of covercrop plants. We may also find that it is especially adapted to steep hillside farming, and that there will be a reduction in the cost of cultivation. It is hoped that it will be possible to prevent some of the so-called June drop by increasing the humidity during a period of very dry weather.

Whether all of these advantages will

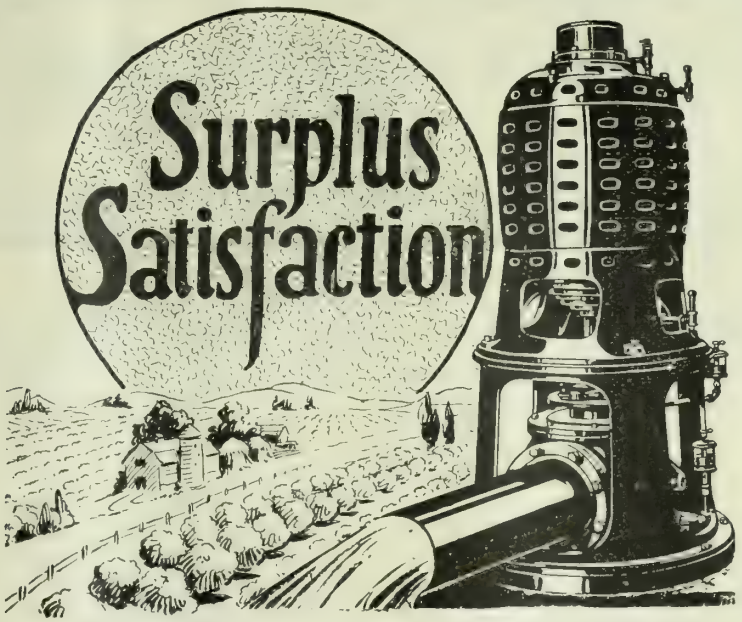
be realized or not remains to be seen. It should be thoroughly understood, however, that we do not have sufficient data at the present time to make any absolutely positive statements. It appears reasonable to expect that through the proper regulation of soil misture, some of them will be effected. Neither have we any information to indicate that insect control will be accomplished. Most of the orchards which have been installed with the overhead system up to the present time, especially those which have been under observation for from three to six years, are in a light type of soil. Orchards in a heavy type of soil, in which the overhead method of irrigation has been used, have not been under observation for a sufficient length of time to draw any conclusions as to the possible effect on the tree so far as certain trunk and root diseases are concerned. Under a light type of soil, we would not expect to run into any difficulties as far these diseases are concerned, but it is well known that in heavy types of soil, where water stands around the trunk of the tree, certain of these fungus trunk and root diseases become apparent.

The cost of installing overhead irrigation equipment cannot be accurately stated because of the varying conditions. In general, however, one can say that the cost is approximately $300 per acre, especially where a booster pump does not have to be installed. If a booster pump does have to be installed, this will naturally run the expense up higher. By using reconditioned pipe, a saving of $25 an acre may be realized. Should a grower care to try the method out in an orchard, without going to the expense of permanent equipment, the portable or semi-portable installation may be used, and the cost cut down very materially.

Drainage Pays the Farmer

(*Continued from Page 15*)

what he can accomplish by the use of small open ditches, random tile drainage and terraces. These improvements are such that they will increase the yield of his farm with scarcely any outlay except of his own time and labor. There are two ways of increasing income; one is to cut down the cost of operation, the other to increase the production without increasing cost of operation. Better drainage will increase production and cut down cost of operation. I know of no better type of improvement at the present time than those that I have described. This is the kind of drainage that pays dividends from the start, and if carefully planned should prove profitable to any farmer who has wet or eroding land that needs improvement.



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SURVEY *of* HYDRAULIC DEVELOPMENT

As Shown by Official Records of the Month -- Local, State, and Governmental

Applications Filed

Among the applications for permit to appropriate water filed with the State Department of Public Works, Division of Water Rights, (California) during the month of March were the following:

Application No 4936 (San Diego County) —Gustar Ahlzen, c/o C. E. Burch, 205 Security Bank Bldg., San Diego, Calif., for .075 cubic foot per second from unnamed spring and Show Canyon. To be diverted in Section 5, T 12 S, R 4 E, and Sec. 6, T 12 S, R 4 E, S.B.M. for domestic and irrigation on 5 acres. Estimated cost $5,000.

Application No. 4937 (Riverside County)— F. D. R. Moote, 517 H. W. Hellman Bldg., Los Angeles, Calif., for .12 cubic foot per second from N. Fork San Jacinto River tributary to San Jacinto River. To be diverted in Section 24, T 4 S, R 2 E, for irrigation and domestic purposes on 100 acres. Estimated cost $5,000.

Application No. 4940 (Glenn County)— Glenn-Colusa Irrigation Dist., c/o F. H. Tibbitts, Alaska Commercial Bldg., San Francisco, Calif., for 3000 cubic feet per second from Sacramento River tributary to Suisun Bay. To be diverted in Section 2, T 22 N, R 2 W, M.D.M. for power purposes in Sec. 5, Glenn Ranch Survey, 12,955 H.P. to be developed. Estimated cost $2,000,000.

Application No. 4941 (Marin County)— Leo M. Harvey and Louis Evans, c/o Gouge, Robinson & Hughes, 622-627 C. C. Chapman Bldg., Los Angeles, Calif., for 2 cubic feet per second from Olema Creek and Bear Valley Creek tributary to Tomales Bay. To be diverted in Section 12, T 2 N, R 9 W, and Section 17, T 2 N, R 8 W, M.D.M. for irrigation and domestic purposes on 640 acres. Estimated cost $30,000.

Application No. 4942 (Contra Costa County) Rindge Land Reclamation Dist., No. 2036, P. O. Box 785, Stockton, Calif., for 30.8 cubic feet per second from Old River, Rock Slough, India Slough tributary to San Joaquin River. Movable diversion in Sections 1, 11 and 12, T 1 N, R 3 E, and Sec. 36, T 2 N, R 3 E and Secs. 5, 6, 7, and 8 T 1 N, R 4 E, and Sec. 31, T 2 N, R 4 E, M.D.M. for irrigation purposes on 2464.6 acres in Palm Tract.

Application No. 4943 (San Joaquin County)—Rindge Land Reclamation Dist., No. 2037, P. O. Box 785, Stockton, Calif., for 85.45 cubic feet per second from San Joaquin River Disappointment, 21 mile and 14 mile sloughs tributary to San Joaquin River. Movable diversion in Sections 1 and 12, T 2 N, R 4 E, and Secs. 5 to 11 inc., 13 to 18 inc., 20 to 24 inc., 26 to 29 inc., T 2 N, R 5 E, M.D.M. for irrigation purposes on 6836 acres in Rindge Tract.

Application No. 4944 (San Joaquin County)—Rindge Land Reclamation Dist., No. 2038, P. O. Box 785, Stockton, Calif., for 71.74 cubic feet per second from Empire Cut, Whiskey Slough and Middle River tributary to San Joaquin River. Movable diversion in Sections 1, 2, 3, 10, 11, 12, 13, 14, 15 and 16, T 1 N, R 4 E, and Secs. 5, 6, 7, 8, 9, 16, 17, and 18, T 1 N, R 5 E, M.D.M. for irrigation purposes on 5,739 acres on Lower Jones Tract.

Application No. 4945 (San Joaquin County—Rindge Land Reclamation Dist., No. 2039, P. O. Box 785, Stockton, Calif., for 78.6 cubic feet per second from Trappers Slough, and Middle River tributary to San Joaquin River. Movable diversion in Sections 13 to 16 inc., 21 to 27 inc., 35 and 36, T 1 N, R 4 E, and Secs. 16 to 21 inc. and 29 and 30, T 1 N, R 5 E, M.D.M. for irrigation purposes on 6288.6 acres on Upper Jones Tract.

Application No. 4951 (Butte County)— Herbert W. Barman, P. O Box 85, Chico, Calif., for 10 cubic feet per second from Canal of Drainage Dist. No. 100, tributary to Sacramento River. To be diverted in Sections 30 and 31, T 19 N, R 2 E, M.D.M. for irrigation purposes on 700 acres of rice in Secs. 25 and 26, T 19 N, R 1 E, and Secs. 30 and 31, T 19 N, R 2 E, M.D.M. Estimated cost $1000.

Application No. 4953 (San Diego County)—Frank A. Hansom, Escondido, Calif., for .075 cubic foot per second underground water tributary to Escondido River. To be diverted in Section 16, T 12 S, R 2 W, S.B.M. for irrigation and domestic purposes on 4 acres. Estimated cost $1200.

Application No. 4956 (Butte County)— Mrs. Kate Haack, 1201 Robinson Street, Oroville, Calif., for 3.2 cubic feet per second from Lateral E. I. No. 833 Drainage Ditch tributary to Sacramento River via Butte Creek. To be diverted in Section 6, T 17 N, R 2 E, M.D.M. for irrigation purposes on 128 acres of rice in Sec. 6, T 17 N, R 2 E, M.D.M.

Application No. 4957 (Riverside County) —Herman Luhrman, Palm Springs, Calif., for .12 cubic foot per second from E. Fork Stubby Creek tributary to Whitewater River. To be diverted in Section 36, T 2 S, R 2 E, S.B.M. for irrigation purposes on 10 acres Sec. 36, T 2 S, R 2 E, M.D.M. Estimated cost $800.

Application No. 4958 (Los Angeles County)—The Women's Home Missionary Society of the Methodist Episcopal Church of Southern California Conference, c/o J. A. Allard, 313 First National Bank Bldg., Pomona, Calif., for .29 cubic feet per second waste water tributary to San Dimas Wash. To be diverted in Section 2, T 1 S, R 9 W, S.B.M. for irrigation purposes on 23 acres.

Application No. 4959 (Butte County)— Manly S. Harris, 116 Post St., San Francisco, Calif., for 15 cubic feet per second from Main Canal and Lateral C Drainage Dist. No. 833 tributary to Sacramento River. To be diverted in Sections 3 and 10, T 17 N, R 1 E, M.D.M. for irrigation and stock purposes on 2,510 acres in Secs. 10, 13, 14, 16, 21, 22 and 23. Estimated cost $10,000.

Application No. 4961 (Stanislaus County) —C. C. Crookshank, c/o L. J. Maddux, Modesto, Calif., for 2.54 cubic feet per second from Tuolumne River tributary to San Joaquin River. To be diverted in Section 17, T 4 S, R 8 E, M.D.M. for irrigation purposes on 203 acres in Sec. 17, T 4 S, R 8 E, M.D.M. Estimated cost $3500.

Application No. 4962 (Lassen County)— E. A Julian, 421 Crocker First National Bank Bldg., San Francisco, Calif., for 17,000 acre feet per annum from Long Valley Creek tributary to Honey Lake. To be diverted in Section 10, T 23 N, R 17 E, M.D.M. for irrigation purposes. Estimated cost $216,000.

Application No. 4963 (Butte County)— Edward Schirmer, Gridley, Calif., for 4 cubic feet per second from Lateral E—Reclamation Dist. No. 833 tributary to Sacramento River via Butte Creek. To be diverted in Section 33, T 18 N, R 2 E, M.D.M. for irrigation purposes on 300 acres of rice in Sec. 33, T 18 N, R 2 E, M.D.M. Estimated cost $1000.

Application No. 4964 (San Diego County) —Hugh Hendershot, c/o A. R. Arnold, Escondido, Calif., for .12 cubic feet per second Underground Water tributary to Escondido River. To be diverted in Section 16, T 12 S, R 2 W, S.B.M. for irrigation and domestic purposes on Lot 4, Block 147, Rancho Rincon del Diablo projected Sec. 16, T 12 S, R 2 W, S.B.M. Estimated cost $1200.

Application No. 4965 (San Bernardino County)—J. C. Miller, San Bernardino, Calif., for 0.12 cubic feet per second from spring tributary to Hook Creek. To be diverted in Section 13, T 2 N, R 3 W, for domestic purposes in SW ¼ Sec. 13, T 2 N, R 3 W. Estimated cost $125.

Application No. 4968 (Inyo County)—Roy Journigan, Lone Pine, Calif., for 3.20 cubic feet per second from unnamed stream tributary to Lone Pine Creek. To be diverted in Section 31, T 15 S, R 34 E, M.D.M. for domestic and irrigation.

Application No. 4970 (Kern County)—E. B. Hilborn, Leliter, Calif., for .37 cubic foot per second from Short Canyon (7 springs) tributary to Inyokern Valley. To be diverted in Section 31, T 25 S, R 38 E, M.D.M. for agriculture and domestic purposes on 40 acres in Sec. 31, T 26 S, R 38 E. Estimated cost $3500.

Application No. 4971 (Humboldt County) —City of Eureka, Eureka, Calif., for 4400 acre feet per annum from Jacoby Creek tributary to Humboldt Bay. To be diverted in Section 30, T 5 N, R 2 E, H.M. for municipal and domestic in City of Eureka. Estimated cost $500,000.

Application No. 4975 (Ventura County)— Guy T. Stetson, Henry S. Nixon, Trustees, proposed Ojai Irrigation District, c/o J. B. Lippincott, 543 Petroleum Security Bldg., Los Angeles, Calif., for 30,800 acre feet per annum from Sespe Creek tributary to Santa Clara River. To be diverted in Section 6,

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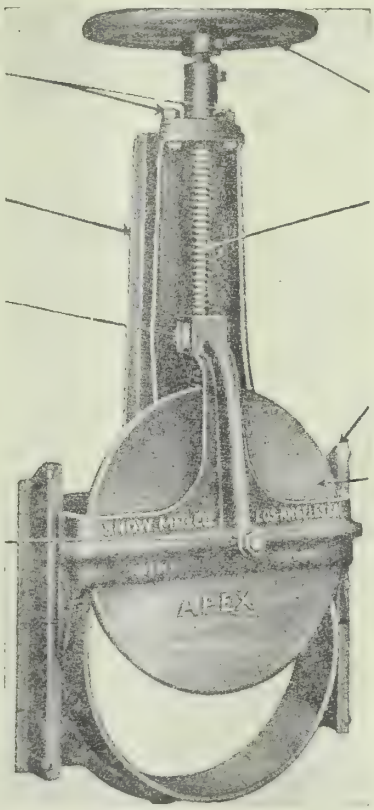

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T 5 N, R 22 W, S.B.M. for power purposes in Sec. 31, T 5 N, R 22 W, S.B.M. 6818 H.P. to be developed. Estimated cost $2,060,000.

Application No 4977 (Santa Barbara County)—J. G. Reinhart, c/o Preisker, Preisker & Goble, Bank of Santa Maria Bldg., Santa Maria, Calif., for 0.73 cubic foot per second underground water tributary to Los Alamos Creek. To be diverted in Section 21, T 8 N, R 33 W, S.B.M. for irrigation purposes on 58.43 acres in Sec. 21, T 8 N, R 33 W, S.B.M. Estimated cost $2500.

Application No. 4978 (Contra Costa County)—Sleepy Hollow Syndicate, 1622 Harrison St., Oakland, Calif., for 80 acre feet per annum from unnamed stream tributary to San Pablo Creek. To be diverted in Sections 27 and 28, T 1 N, R 3 W, M.D.M. for domestic and irrigation purposes on 190 acres,—Golf Links and parks.

Application No. 4979 (San Joaquin County—Ira E. Saunders, c/o Ohm & Raab, 517 E. Market St., Stockton, Calif., for 0.96 cubic feet per second from Middle River tributary to San Joaquin River. To be diverted in Section 1, T 1 S, R 5 E, M.D.M. for irrigation purposes in Secs. 1 and 12, T 1 S, R 5 E, M.D.M. Estimated cost $2000.

Application No. 4980 (Lassen County)—Red Rock Creek Irrigation Dist., c/o Secretary, Red Rock, Lassen, Calif., for 16,500 acre feet per annum from Red Rock Creek tributary to Madeline Plains. To be diverted in Sections 5 and 10, T 35 N, R 16 E, and Section 22, T 36 N, R 16 E, M.D.M. for irrigation purposes on 10,260 acres. Estimated cost $76,800.

Application No. 4981 (Lassen County)—Red Rock Creek Irrigation Dist., c/o Secretary, Red Rock, Lassen Co., Calif., for 8,100 acre feet per annum from Cold Springs Creek tributary to Madeline Plains. To be diverted in Section 25, T 36 N, R 15 E, M.D.M. for irrigation purposes on 10,260 acres. Estimated cost $26,800.

Application No. 4982 (Los Angeles County)—Ralph Bennett, 1125 Central Bldg., Los Angeles, Calif., for 15,000 acre feet per annum from Big Rock and Pallett Creeks tributary to Antelope Valley. To be diverted in Section 6, T 4 N, R 9 W, S.B.M. for irrigation purposes on 5000 acres in T 4 & 5 N, R 9 & 10 E, S.B.M.

Application No. 4983 (Trinity County)—Lewiston Dredging Co., 725 Standard Oil Bldg., San Francisco, Calif., for .01 cubic foot per second from Big Roycroft Gulch tributary to Trinity River. To be diverted in Section 21, T 34 N, R 8 W, M.D.M. for irrigation and domestic purposes on 6 acres in Sec. 22, T 34 N, R 8 W, M.D.M. Estimated cost $1000.

Permits Issued

Among the more important permits to appropriate water issued by the Department of Public Works, Division of Water Rights of California, during the month of March, 1926, were the following:

Permit No. 2447, Application No. 4663 (Butte County)—Issued to E. L. Adams, Chico, Calif., March 19, 1926 for 22.5 cubic feet per second from Hamlin Slough in Section 8, T 20 N, R 2 E for irrigation of 1214.9 acres near point of diversion. Estimated cost $400.

Permit No. 2448, Application No. 4664 (Butte County)—Issued to Gorrill and Hotchkiss, Chico, Calif., March 19, 1926 for 22.5 cubic feet per second from Hamlin Slough in Section 17, T 20 N, R 2 E, for irrigation of 2338.3 of rice near point of diversion. Estimated cost $250.

Permit No. 2449, Application No. 4665 (Butte County)—Issued to Gorrill and Hotchkiss, Chico, Calif., March 19, 1926 for 15 cubic feet per second from Butte Creek in Section 7, T 20 N, R 2 E, for irrigation of 2338.3 acres near point of diversion. Estimated cost $1500.

Permit No. 2450, Application No. 4821 (Sacramento County)—Issued to Chas. A. Driver, Roseville, Calif., for 0.44 cubic feet per second from Dry Creek in Section 14, T 10 N, R 5 E, for irrigation of 35 acres in Sec. 14. Estimated cost $1000.

Permit No. 2451, Application No. 4836 (San Bernardino County)—Issued to Pozzo Construction Co., Los Angeles, Calif., March 31, 1926 for 0.1 cubic foot per second from Tunnels in Brodek Canyon in Section 18, T 1 N, R 6 W, for domestic and irrigation of 80 acres in Sec. 25, T 1 N, R 7 W.

OREGON

Among the more important applications for permit to appropriate water filed in the office of Rhea Luper, state engineer of Oregon, during March were the following:

B. G. Macy of Sparta, covering the appropriation of water from Saw Mill Gulch for irrigation of 10 acres in Baker County.

Lewis G. Haven of Portland, covering the appropriation of water from Banning Creek for irrigation of 40 acres in Josephine County, at a cost of $600.

G. H. Smith of Santa Ana, California, covering the appropriation of water from Board Shanty Creek for irrigation of 12 acres in Josephine County.

Lenn J. Smith of Crescent, covering the appropriation of water from Crescent Creek for irrigation of 58 acres in Klamath County, at a cost of $300.

A. H. Shafer of Enterprise, covering the appropriation of water from Hurricane Creek for supplemental irrigation of 15 acres in Wallowa County.

Chester I. Simmers of Crescent, covering the appropriation of water from Crescent Creek for irrigation of 40 acres in Klamath County, at a cost of $300.

M. B. Chapman of Camas Valley, covering the appropriation of water from Coquille River for irrigation of 16 acres at a cost of $500; also, covering the appropriation of water from an unnamed creek for domestic purposes in Douglas County.

J. H. Griffith of Williams, covering the appropriation of water from Cherry Gulch for irrigation of 16 acres in Josephine County, at a cost of $250.

M. J. Lee, Trustee, of Canby, covering the appropriation of water from Molalla River, natural flow, seepage, waste, and stored water, for irrigation and power purposes in Clackamas County.

Mr. Sherman J. Warner of Mt. Vernon, Oregon, covering the appropriation of water from Rann Creek for irrigation of 15 acres, in Grant County.

Mr. John J. Rathkey of Looking Glass, Oregon, covering the appropriation of water from Ten Mile Creek for irrigation of 15 acres, in Douglas County, at a cost of $1,000.

M. A. S. Welch of 126 Lombard St., Portland, Oregon, covering the appropriation of water from an unnamed stream for irrigation of 10 acres, in Clackamas County, at a cost of $200.

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Mr. Clarence M. Bogart of Richland, Oregon, covering the appropriation of water from Squaw Gulch for irrigation of 20 acres, in Baker County, at a cost of $200.

Mr. G. Evert Baker of Northwestern Bank Bldg., Portland, Oregon, covering the appropriation of water from an unnamed stream, tributary of Devil's Lake, for municipal purposes, in Lincoln County.

Mr. J. H. Woodcock of Maupin, Oregon, covering the appropriation of water from Clear and Frog Creeks for the construction of Clear Lake Reservoir for the storage of 20,000 acre feet. Proposed to use the stored water for irrigation and domestic purposes in Wasco County.

City of Eugene, covering the construction of the Bear Creek Reservoir for storage of 30,000 acre feet of water from McKenzie River, and the appropriation of the stored water and water from McKenzie River, and Johnson Creek for development of 23,863 theoretical horsepower; also the appropriation of 5,200 cubic feet per second of water from The McKenzie River and water stored in the Bear Creek Reservoir for development of 71,363 theoretical horsepower. The proposed development will cost approximately $4,281,780, and is within Lane County.

Johnie G. Warner of Trail, covering the appropriation of water from Wall Creek for irrigation of 15 acres in Jackson County, at a cost of $300.

J. H. Woodcock and L. C. Henneghan of Maupin, covering the appropriation of water from Boulder Creek, Clear Creek and White River for irrigation of approximately 15,000 acres in Wasco County.

Fred R. Young of Pendleton, covering the appropriation of water from Mountain Creek for irrigation of 13 acres in Umatilla County.

Howell Ditch Company of Richland, covering the appropriation of seepage water from Waterbury-Allen Ditch for supplemental irrigation of 418 acres in Baker County, at a cost of $9,000.

Denied Service Extension

The application of the Pismo Beach Water Company, a utility serving a few consumers in a real estate subdivision adjacent to the town of Pismo, for permission to furnish water to the town of Pismo Beach, has been denied by the California Railroad Commission, the Commission having recently authorized a group of responsible citizens of Pismo Beach to take over and operate El Pismo Water Company, formerly operated by W. W. Ward. The new owners of El Pismo Water Company will carry out the program of improvement of the service ordered by the Commission.

Rate To Be 12c per 100 Cu. Ft.

Belvedere Water Corporation, supplying consumers in vicinity of Belvedere Gardens, Los Angeles County, has been authorized by the California Railroad Commission to place in effect a rate of 12 cents per 100 cubic feet for all water delivered to consumers in excess of 5,000 cubic feet per month on and after April 1, 1926, in place of the present rate of six cents.

Would Extend System

Euclid Avenue Water Company, Los Angeles County, has applied to the California Railroad Commission for permission to extend its public utility service to a tract of 10 acres adjoining its present system, and to issue 100 shares of stock for the purpose of financing such extension.

Commission Orders Rate Reductions

The California Railroad Commission, in a decision rendered March 20, ordered adjustments in the rates, rules and regulations of the Sutter-Butte Canal Company, operating in Sutter and Butte Counties, California, which will result in the reduction of rates for rice irrigation in the main territory served, and the elimination of so-called "continuous contracts" which have been a bone of contention between the company and the water users for a number of years.

Under the terms of the decision, the chief reductions of rates for irrigation water for rice growing are: reduction of the rates for gravity flow water in the Butte and Sutter County area, 45 cents per acre per year; reduction of the rate on pumped water, 65 cents per acre per year, and establishment of prepayment discounts on service charges. The pumping rate will be decreased from $10.45 per acre per year to $9.80; gravity water rates will be reduced from $8.95 per acre per year.

Asks Commission Refuse Authority

Moor Park Farmers Water Company of Moor Park, Ventura County, California, has filed a complaint with the California Railroad Commission against A. H. Hitch, requesting the Commission to refuse to authorize the latter to engage in a public utility water business for the purpose of supplying Ventura County Water Works No. 1 or the county of Ventura with water to the detriment of the existing business of complainant.

Seeks New Rate Schedule

Citizens Water Association, which recently took over the property of El Pismo Water Company, Pismo, California, has applied to the Railroad Commission, for authority to establish a schedule of rates producing a fair return upon the property, and permitting of the carrying out of improvement of the system as agreed upon when the system was taken over from its former management.

Sonoma Company to Sell

Permission has been granted by the California Railroad Commission to the Sonoma Water and Irrigation Company to use $10,160 obtained from the sale of its eight per cent cumulative preferred stock to acquire the public utility water system of A. E. Joscelyn, who operates under the fictitious name of Sonoma Vista Water Company.

Wants Permit to Issue Stock

Plymouth Water Company, engaged in the business of selling water for domestic and irrigating purposes at Plymouth, Amador county, California, has applied to the state Railroad Commission for authority to issue 4950 shares of its capital stock to M. C. Randolph.

Would Sell Garden Grove System

Garden Grove City Water Company, engaged in supplying water to the town of Garden Grove, Orange County, California, has applied to the Railroad Commission of the state for permission to sell said system to Orange County Water Works District No. 3.

Time for Sale Extended

An extension of time has been granted by the California Railroad Commission to Conservative Water Company, until December 31, 1926, in which to issue and deliver bonds previously authorized by the Commission.

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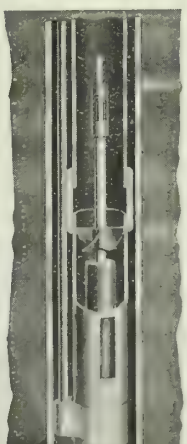

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AMONG OUR CONTRIBUTORS

Editorial Jottings About Current and Forthcoming Feature Articles, Dealing With Practical Problems of Hydraulics, and the Men Who Have Written Them

GORDON ZANDER, who writes of the adjudication of water rights in California, was born in San Rafael, in that state, was educated in the public schools of Oakland, and was graduated from the University of California in 1913. After having filled minor engineering positions with the Pacific Gas and Electric Company, the Spring Valley Water Company and the California Highway Commission, he entered the employ of the State Water Commission of California in 1917. For the past nine years he has been with the State Water Commission and its successor, the Division of Water Rights, continuously with the exception of a period of about a year and a half during the World War, when he was on active duty in the United States Army. Since 1920 he has served in the capacity of Associate Hydraulic Engineer, in charge of the adjudication and water distribution work of the Division.

DOZIER FINLEY, author of the article on corrosion of underground pipe, was graduated from the University of California in the class of 1902, having specialized in chemical engineering, with particular reference to the oil and asphalt industries. For eleven years subsequent thereto he was chief chemist and in charge of engineering for The Paraffine Paint Company and was in charge of chemical work until the entry of the United States into the world war.

He was a captain in the ordnance department during the war, having charge of the manufacture of certain special explosive and pyrotechnic materials for the ammunition section. Since the war he has been in charge of technical research work for The Paraffine Companies, Inc., and has given particular attention to the problem of protection of underground irrigation, gas, water and oil pipe.

He is a member of The American Chemical Society, The American Society for Testing Materials, The American Gas Association and The Pacific Coast Gas Association.

ORSON WINSO ISRAELSON, who tells what irrigation has done for Utah, is one of the scholarly men whose abilities have been directed toward the service of irrigation through research and education. He was born in Utah and educated there, receiving the Bachelor of Science degree from the Agricultural College of Utah in 1912. In 1913 and 1914 he served with the Division of Irrigation Investigations of the Department of Agriculture, and received his Master's degree from the University of California in 1914. For the following two years he taught as an instructor in experimental irrigation at the University of California, going to the Agricultural College of Utah in 1916, and remaining there until the present time, first as assistant professor of irrigation and drainage, later as associate professor and finally professor and head of the department. In 1925 he was awarded the degree of Doctor of Philosophy from the University of California, having prepared his thesis on "The Application of Hydrodynamics to Irrigation and Drainage Problems." In addition to his educational work he has done consulting work with special reference to problems in duty of water connected with water-right adjudications. He is a member of a committee appointed by the Irrigation Section of the American Society of Civil Engineers to investigate the consumptive use of irrigation water. He is the author of a large number of articles in this field for the technical press and official bulletins.

GORDON ZANDER

S. H. MCCRORY and W. W. MCLAUGHLIN are the men who head the invaluable work that is being done in irrigation and drainage by the Division of Agricultural Engineering of the U. S. Department of Agriculture. Mr. McCrory is chief of the division, and has charge of drainage investigations; Mr. McLaughlin is associate chief, and is at the head of irrigation investigations. Both of these men have been in the government service for many years and are recognized for their knowledge of the field and their considerable contributions to its technique and literature. Mr. McLaughlin's article is a continuation of the "An Outline of Irrigation" which appeared in the March issue, in which he traced the development of irrigation and of his division during the past thirty years. Mr. McCrory's article is a republication of a paper which he delivered before a recent middle-west convention.

C. H. PEASE, writing on "Two Rivers of Doubt," has already been introduced to the readers of MODERN IRRIGATION. His article is the second part of "The Riddle of the Rio Grande," published in the last issue. W. H. SNELSON is senior irrigation specialist of the Dominion Irrigation and Reclamation Service, stationed at Calgary, Alberta, Canada. His article on the water requirements of winter wheat is a presentation of the results of eight years of experimenting on this subject by himself and associates. HUGH CRANE is a regular staff contributor.

NATHAN T. VEATCH, JR., author of the article entitled "Stream Pollution is a National Problem," is a consulting engineer in private practice in Kansas City, Missouri, a member of the firm Black & Veatch. He was educated in the middle west, and obtained his earliest experience in railroad work with the Santa Fe. In 1909 he was in charge of the design of a sewage system and sewage disposal plant for the city of Holton, Kansas, following this experience with drainage survey work. Later in 1909 he served as resident engineer for Worley & Black, consulting engineers, on two municipal water and light plants, and the following year became that firm's principal assistant. He was connected with the American Water Works and Electric company, for a time in their head offices at Pittsburgh, Pennsylvania, but for the most part of the connection serving as superintendent of the City Water Company at Keokuk, Iowa. In 1914 he entered private practice under the firm name of Black and Veatch and has been successfully practicing since that time. He has perfected many special features in connection with water and sewage purification plants, such as chemical feeding apparatus and control apparatus. A large number of civic and technical organizations number him as a member, and he has contributed many articles to the technical press.

PAUL BAILEY, deputy chief of the Division of Engineering and Irrigation of the California Department of Public Works, is a man with a mission. He is in charge of the investigation of one of the most audacious and stupendous irrigation projects ever conceived, which, among other features, would turn the San Joaquin River around and make it flow from the ocean toward its source. He will describe this project and the investigations which are being made, in the May issue of MODERN IRRIGATION.

HYDE FORBES, consulting hydraulic engineer, is interested, as a great many readers of MODERN IRRIGATION are, in the relative merits of general and special engineering studies for students planning on entering some phase of irrigation or water development work. He places the problem before you for discussion in the May issue.

GEORGE SWENDSEN is one of the well-known engineer-managers of the west. He is chief engineer and general manager of the Fresno (Calif.) Irrigation district. His address before the recent meeting of the California Irrigation Districts Association on "Irrigation District Management." It will be published in the May issue of MODERN IRRIGATION.

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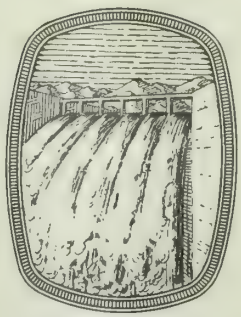
PETROLEUM WORLD 626 S. SPRING ST., LOS ANGELES, CALIF. MODERN IRRIGATION

HUBERT WORK

Secretary of the Interior, whose speech in Los Angeles in April on the subject of the Colorado River and its development was the chief sensation of the month, and who was in the southwest, accompanied by Elwood Mead, Commissioner of Reclamation, studying various aspects of the proposed Boulder Canyon project. Dr. Work has committed himself to having some definite proposal to submit to Congress when it convenes next December.

MODERN Irrigation
The Magazine of Applied Hydraulics



Volume II MAY, 1926 Number 5

The Progress *of* Irrigation

SPEAKING to an audience which he addressed as "the representative people of California," Hubert Work, Secretary of the Interior, on April 26 made a commitment on the subject of the Colorado River that is regarded by many observers as equally significant to that recorded a few days earlier, when the Senate Committee on Irrigation and Reclamation reported the Swing-Johnson bill favorably by a vote of 12 to 3.

Secretary Work appeared in Los Angeles as the guest of two civic organizations, accompanied by Dr. Elwood Mead, his Commissioner of Reclamation and his chief dependence in matters affecting this aspect of the Department's work. His address was heard by 850 persons. Twice his audience interrupted to applaud his statements, once when he asserted that "for the first time concrete, specific recommendations, comprehending the diversified and co-ordinated use of the river were made to Congress by the present administration of the Interior Department," and again when he declared: "If there are those among you who for personal, partisan or political advantage are embarrassing this project, they should be excluded from our councils."

TWO OTHER statements in his address were of special importance. After tracing the legislative history of the Boulder Canyon project, and broadly intimating that the early adjournment of Congress might find definite action still lacking, in spite of the senate committee's favorable report, he said:

"Should Congress fail to instruct the Secretary of the Interior to secure contracts for the sale of power and water from the Colorado River, to potential consumers, he proposes to initiate such procedure himself and, if possible, have formulated something tangible to present to Congress when it meets next winter."

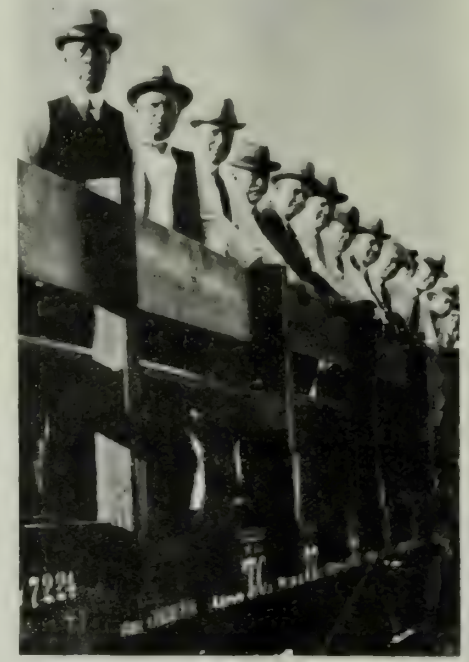
In concluding his remarks, during the course of which he had argued that the complex interests and diverse considerations involved in the development of the Colorado make it properly and necessarily a field for government activity, the Secretary asserted:

"If an organized corporation, competent and willing to develop this project in its several ramifications, will come forward and submit a contract to build these structures and place their operation under such control of the Government as will protect the many and diversified interests involved, the Secretary of

the Interior will recommend to Congress that such proposition be sympathetically entertained."

This statement was variously interpreted by listeners. Some considered it to be a suggestion that the project should be no longer delayed, and that, if federal action could not soon be decided upon, the way should be cleared for private exploitation. Others saw in it a hint that the City of Los Angeles, regarded as an "organized corporation," might be considered as a proper agency for undertaking the project, the government failing to assume the responsibility; while another element chose to accept it as a challenge to private corporations to advance plans which would insure the safeguarding of all interests under a plan of private development. Secretary Work was quoted, in the press, as explaining this statement as such an invitation to the power corporations to come forward with an adequate plan for private work under government control.

The greater part of the Secretary's address is given in another part of this issue.



SENATE IRRIGATION COMMITTEE IN MEXICO

This picture was taken when the senate committee was in the southwest last fall, investigating the Colorado River situation, and shows the shirt-sleeved solons on the crest of the Pescadero Dam, 26 miles below the Mexican border.

THE favorable report of the senate committee on irrigation was the second event of the month which earlier indicated progress in the direction of federal action on the Colorado River controversy and gave encouragement to those favoring the plan outlined in the Swing-Johnson bill. After a group of amendments presented by the upper basin states had been added to the measure, it came to a vote by the committee on April 23 and was favorably reported by a vote of twelve to three, the opposition consisting of Arizona's two members, Senators Ashurst and Cameron, and Senator Phipps of Colorado. These three have been counted as the foes of the measure.

The senators who voted in favor of the measure in committee were: McNary of Oregon, committee chairman; Kendrick, Wyoming; Jones, Washington; Shortridge, California; Johnson, California; Sheppard, Texas; Walsh, Montana; Pittman, Nevada; Simmons, North Carolina; Dill, Washington; Gooding, Idaho and Oddie, Nevada.

Some partisans have been encouraged by this action to believe that the passage of the bill is a possibility before Congress adjourns, and the legislative fathers of the measure have announced that they will push it to conclusion if possible in the month or so remaining in this session, concentrating their efforts before the House Committee on Irrigation and Reclamation. The indications are, however, that final action will not be obtained, and that the summer recess will intervene before the fate of the measure will be known.

REPORTS from various sections of the irrigation country have a prevalent tenor of optimism as the 1926 irrigation season opens. Ample rainfall has assured a plentiful supply of water in most parts of the west, has relieved the long continued dry period in Northern and Southern California, and from Arizona comes word that 424,484 acre-feet of water stand in the Roosevelt Reservoir.

New irrigation districts are being organized in almost all of the irrigated states, large construction programs are being conceived and launched by the more flourishing districts, and western municipalities are responding to their increasing population by advanced and ambitious programs for the development of domestic supplies.

Congress, before it adjourns, will probably approve a federal reclamation program somewhere midway between extreme conservatism and undue optimism, which, as a compromise between the "defeatists" and the pork-barrel, will perhaps be as wise a course as it is possible to obtain. The final appropriations will care for large works now in preparation, will grant much-needed relief to some harassed districts, and will make funds available for some new projects.

Fundamentals of District *Management*

Irrigation Districts Represent "Big Business"; Must Be Directed on Principles that Control Other Great Business] Enterprises

Says
GEORGE L. SWENDSEN
Chief Engineer and General Manager, Fresno Irrigation District.

TOP
Concrete Check Dam in Main Canal of the Fresno Irrigation District.

CENTER
Diversion Gates on the District's Main Fresno Canal.

LOWER
A Lined Section of the Main Canal. These Pictures Prove that Irrigation is Not Without its Aesthetic Appeal.

IRRIGATION DISTRICTS are organizations of big business. In California alone there are eighty-six active irrigation districts organized and functioning under the state irrigation district act. The aggregate area of these districts is given as 3,434,992 acres and the aggregate of authorized bond issues as $120,020,831.

Seventy-two of these district organizations, comprising 2,210,000 acres, approximately two-thirds of the whole area, have been brought about within the last ten years. From reliable sources we are informed that, of the bond issues authorized, approximately $75,000,000 have been sold and presumably the funds thus secured, together with funds otherwise provided, are invested in the irrigation systems of the various districts.

To carry on the work of annual maintainance, operation and improvements to the canal systems, to pay interest on bonds and to provide funds for retiring bonds as they become due requires assessments on the lands within these districts involving an aggregate amount of probably $10,000,000 annually. These facts alone justify the statement which introduces this article. But when we consider that these institutions have vested in them water rights and franchises many times more valuable than the investment in works and facilities we must certainly conclude that such institutions are of necessity of very great importance in our economic welfare.

When we further consider that irrigation is a paramount necessity to agricultural production in the vast area within the confines of these districts we are reminded that these irrigation agencies are, in reality, the very foundation of our agricultural activities.

It will doubtless be profitable and of some interest to consider some phases pertaining to the conduct of the business belonging to these enterprises of big business, especially as related to the operation and maintainance problems. Much interest always attaches to construction features, especially on new projects, but these are usually peculiar to individual projects, while there are many problems of operation and maintainance common to all districts.

Our law vests the control of district affairs in the hands of an elective board of directors with broad powers and duties. As a matter of fact, there is probably no public institution wherein the responsible officers are given more latitude in the conduct of affairs than is provided by the California Irrigation District Act. It is certain that the limits of the law cannot be charged with any failure in the conduct of the business of these institutions. The directors are not expected to, and usually do not function in handling the details of the districts business, but are obliged to delegate this duty to an executive. The major physical problems in district operation involve more or less engineering and thus an executive with engineering experience is usually chosen.

Like that of any other business, the progress of the district is dependent almost entirely upon the initiative of the executive. This is true whether the district be large or small. To meet his responsibilities he must be an executive in reality, should thoroughly inform himself on the fundamentals of district procedure, must necessarily acquaint himself thoroughly, by personal contact, with all major problems requiring first consideration and, with the advice and

counsel of the directors, build up the organization that is necessary to meet the requirements of his district.

Generally speaking, irrigation district activities can be considered under four general heads.

(a) Records, accounts and finances, generally in the hands of the Secretary and Treasurer.
(b) Assessment and collection of taxes which are functions of the elective officers which the law provides for these activities.
(c) Operation, maintenance and improvement of the canal system.
(d) Legal guidance and advice.

As to (a) and (b) they are more or less routine efforts and as to (d) it seems we are unable wholly to dispense with it. However, it is important that the executive understand the activities of these departments very thoroughly. He can effect much co-ordination of effort, resulting in more thorough and effective work. He should at least exact from these departments:

(1) A monthly statement by the Tax Collector showing collections and balances.
(2) A monthly statement from the Treasurer showing receipts and bank balances.
(3) A monthly statement from the Secretary co-ordinating and exhibiting all financial activities of the district for the previous month.

Periodic audits, preferably every month, should be made by a competent auditor, checking all financial matters and particularly reconciling (1), (2) and (3). With these major routine matters in hand, with the knowledge that modern, up-to-date, records of finance and assessments are in use, and with thorough safeguards on all financial transactions and obligations, the executive can confidently approve the routine monthly reports of such departments which should be provided for the board of directors at each of their regular monthly meetings.

Of course (c), operation, maintainance and improvement of the canal system, offers an almost unlimited field for the energetic executive. I shall only attempt to stress a few features which I consider most important.

(1) Fundamentally, the operation of a system depends upon the field

GEORGE L. SWENDSEN

forces. The executive, by as much personal contact as possible, through adequately advised superintendents and by periodic educational meetings of these forces, can do much to direct and co-ordinate the efforts of these men and thus put into effective use the plans he should have matured for these activities.

(2) While operation and improvement of neighborhood lateral ditches is not primarily a burden of the district nevertheless the organization should function in these matters to the extent of such advice and judicious co-operation as to bring about the best possible conditions for equitable service. We have found such activities most helpful and appreciated among our landowners.

(3) One important element of successful management is the full co-operation and confidence of the landowners. To gain this the executive must advance to a position of leadership in all phases of irrigation and water supply matters as related to his district and in all cases assist the community generally in any judicious efforts to advance interest in these matters.

(4) The district directors are generally very glad to have the executive bear the burden of necessary direct contact and relations with the landowners and he cannot function effectively in any other manner. However, it is always helpful and desirable that board members be kept fully informed on such matters and that they act directly with the executive in considering matters where precedents and policies may be established, thereby gaining first hand information to assist in final determinations. The competent and judicious executive will always find much desirable assistance in such procedure.

Manager Must Be Co-ordinator

The directors of a district having given due latitude and support to an executive have a right to exact from him that he fully and effectively co-ordinate the work in all departments and render to them, monthly or otherwise as they may require, comprehensive reports concerning all features of the institution's activities.

District Tax Collectors, Assessors

(*Continued on Page 32*)

TEN PRACTICAL QUESTIONS TO ALL PRACTICAL IRRIGATORS

By O. W. Israelsen, Professor of Irrigation and Drainage, Utah Agricultural College

Do You Know:

(1) That most irrigators apply excessive amounts of water to porous, gravelly bench lands?

(2) That gravelly soils usually retain less than one inch depth of water in one foot of soil and never retain more?

(3) That the depth of gravelly soil which sustains crop growth and therefore needs irrigation seldom exceeds two or three feet?

(4) That an irrigation stream of two cubic feet per second, the average size "irrigating" stream in Utah, will supply in one hour and thirty minutes all the water than one acre of gravelly soil 3 feet in depth can retain?

(5) That all irrigation water in excess of what the soil can retain leaches from the bench lands valuable plant food and water-logs the lower lands?

(6) That to avoid waste, irrigation water must be rushed over gravelly land by applying it to narrow strips and in short runs?

(7) That you cannot rush small streams over gravelly, porous land?

(8) That poorly-leveled gravelly land cannot be uniformly covered with water even by the use of large streams and short runs?

(9) That if you fail to know these facts or to apply them in your irrigation practice, failure of crops through leaching of bench lands and water-logging of low-lands is sure to follow?

(10) That it is far easier to prevent injury and crop failure from soil leaching and water-logging than to correct the injury?

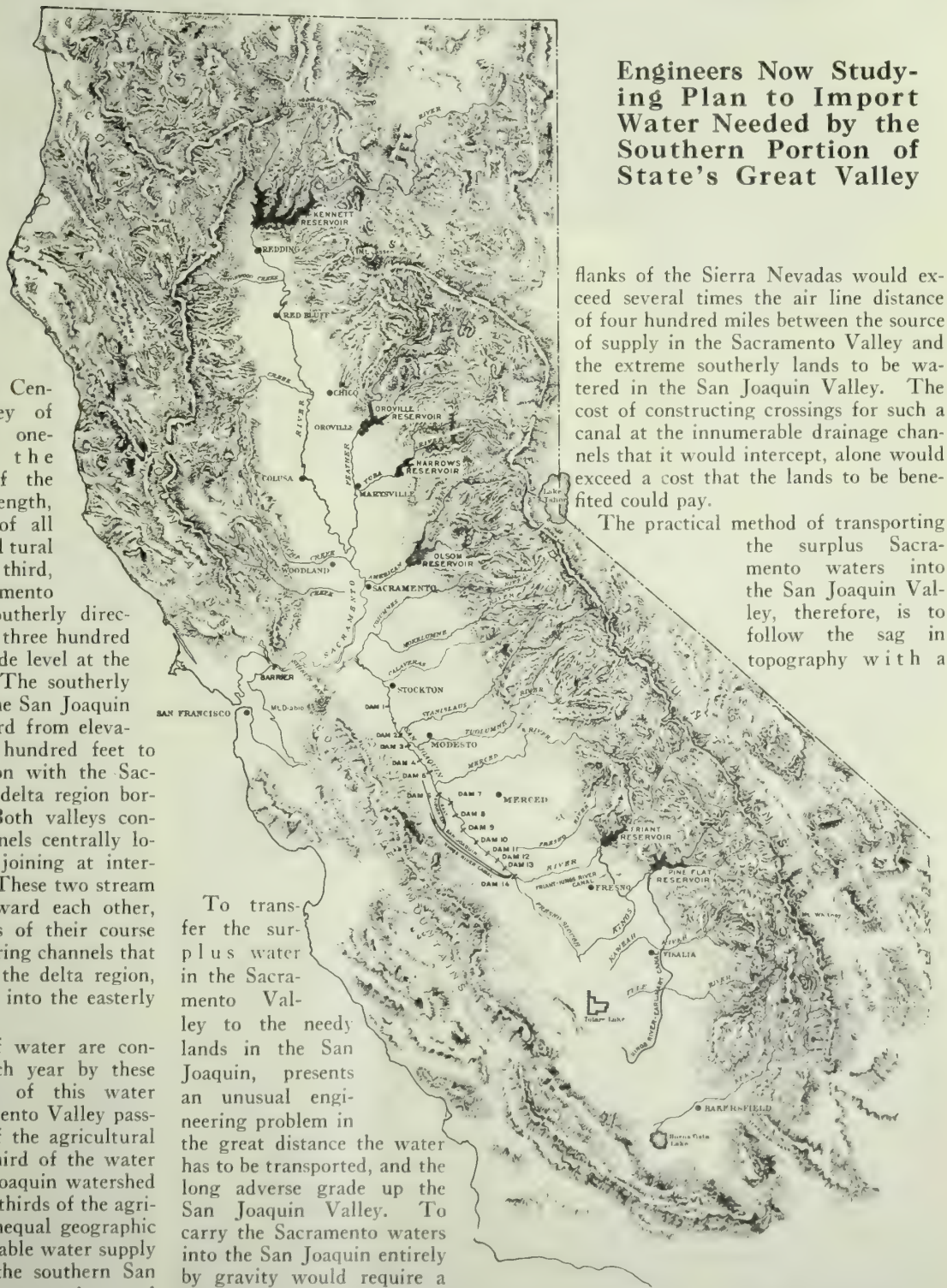
A Plan to Irrigate California by Turning the San Joaquin River Upside Down

By PAUL BAILEY
Deputy State Engineer of California

Engineers Now Studying Plan to Import Water Needed by the Southern Portion of State's Great Valley

THE Great Central Valley of California, one-fourth the breadth of the State and half its length, comprises three-fifths of all California's agricultural lands. The northern third, known as the Sacramento Valley, slopes in a southerly direction from elevations of three hundred feet above the sea to tide level at the head of Suisun Bay. The southerly two-thirds, known as the San Joaquin Valley, slopes northward from elevations of three to five hundred feet to sea-level at the junction with the Sacramento Valley in the delta region bordering Suisun Bay. Both valleys contain main stream channels centrally located with tributaries joining at intervals along their way. These two stream channels in sloping toward each other, meet in the last stages of their course through several meandering channels that separate the islands of the delta region, and then jointly empty into the easterly end of Suisun Bay.

Immense volumes of water are conveyed into the sea each year by these channels. Two-thirds of this water drains from the Sacramento Valley passing by but one-third of the agricultural land, while only one-third of the water originates on the San Joaquin watershed that is tributary to two-thirds of the agricultural land. This unequal geographic distribution of the available water supply causes large areas in the southern San Joaquin Valley to be separated several hundred miles distant from regions of surplus supply in the Sacramento Valley. The intervening topography is smooth enough for easy conduit location but sags greatly in elevation through its middle part.



OUTLINE OF FIRST UNIT OF THE PLAN

This map shows the major features of the plan which is being studied by the California Division of Engineering and Irrigation for the importation of water into the San Joaquin Valley. It is described in more detail in the latter part of the accompanying article, Page 24.

To transfer the surplus water in the Sacramento Valley to the needy lands in the San Joaquin, presents an unusual engineering problem in the great distance the water has to be transported, and the long adverse grade up the San Joaquin Valley. To carry the Sacramento waters into the San Joaquin entirely by gravity would require a long sinuous canal constructed on the steep sides of the Sierra Nevada Mountains. The mountains on the westerly side of the valley lack supporting elevation for such a canal as they approach the head of Suisun Bay. The total length of the sinuous grade line on the flanks of the Sierra Nevadas would exceed several times the air line distance of four hundred miles between the source of supply in the Sacramento Valley and the extreme southerly lands to be watered in the San Joaquin Valley. The cost of constructing crossings for such a canal at the innumerable drainage channels that it would intercept, alone would exceed a cost that the lands to be benefited could pay.

The practical method of transporting the surplus Sacramento waters into the San Joaquin Valley, therefore, is to follow the sag in topography with a

conduit on the smooth valley floor. The low point in this sag is at sea-level at the junction of the two rivers. From this point the water must be raised against the grade of the valley floor for an extreme distance of two hundred and fifty miles.

The engineering advisory committee, in the field, investigating the plans to which Mr. Bailey refers in his article. From left to right, A. J. Cleary, G. A. Elliott, B. A. Etcheverry, A. Kempkey, F. C. Herrman, Paul Bailey, and W. L. Huber. William Mulholland, J. B. Lippincott and Louis Hill are absent members of the committee.

At first glance the problem appears to be insolvable at costs within an economic horizon. The Division of Engineering and Irrigation of the State Department of Public Works has been pursuing a solution to this problem in their Water Resources Investigation that was initiated by the Legislature of 1921. A complete inventory of the waters in all the streams and of the future needs for water, are contained in the Division's first report* to the 1923 Legislature. These studies point out the necessity of irrigation throughout the Great Central Valley and the approaching limit to development in the Southern San Joaquin Valley, unless means are found to overcome the unequal geographic distribution of the natural water supply in the Great Central Valley.

Although much of the land in the Great Central Valley will produce grains and some of it fruits without irrigation, intensive cultivation and diversified cropping require more favorable soil moisture conditions than exist in the natural state. The mean annual rainfall varies from five to twenty-five inches but practically all of this falls during the winter months. The soil moisture can only be maintained in favorable amounts during the long warm summers by artificially adding to the natural supply by irrigation. With irrigation, these lands can be brought to maximum productivity and a great diversity of crops can be grown.

Limit of Resources in Sight

Irrigation has been in progress for many years, especially in the San Joaquin Valley. All the easily developed waters are now in use and less than half of the lands have even an imperfect supply. More water is needed on much of the land already under irrigation in the middle and late summer months during every year, and throughout the season in dry years. Many of the projects in the San Joaquin Valley are now at work formulating construction programs to perfect these supplies. However, the entire mean seasonal run-off of all the San Joaquin Valley streams is only enough to cover its agricultural lands a foot and one-third in depth each season if it all could be conserved. It is estimated that two feet in depth is needed on an average to bring these lands into maximum productivity. This deficiency in supply is greatest in the southern part of the valley that lies at the highest elevations.

Balancing this deficiency in water supply in the southern sections of the Great Central Valley, is a large surplus in the regions to the north. With respect to their needs for water, the mean seasonal run-off of the Sacramento Valley streams is three and one-half times greater than that in the San Joaquin streams and much more than is needed for the full development of the Sacramento Valley. The investigations of the Division of Engineering and Irrigation show that there is ample reservoir capacity on the Sacramento watershed to equalize this streamflow for use in both valleys.

Plans for conveying this surplus of the north to the deficient regions in the south are in the process of formulation and will be the subject of a report by the Division of Engineering and Irrigation to the Legislature of 1927. A report† on a first unit of such a plan was presented to the 1925 Legislature but due to the many complications involved in a scheme of this magnitude, recommendations were withheld until further study could be applied to the problem.

These studies are now in progress under a legislative appropriation for this purpose. They are being directed by the writer in consultation with a committee of eminent consulting engineers who have been called together to advise with the Division of Engineering and Irrigation on this problem.

It is found that the practical method of collecting the surplus waters from the various tributaries of the Sacramento and transporting them through the first half of the distance, is in the channel of the Sacramento River. Although the average grade of the river is about twice that needed for conveying the same water in a canal and there is consequently a loss of head in running the water in the river channel, nevertheless the cost of excavating a new channel far exceeds the value of this loss in head.

The surplus waters of the Sacramento would then arrive at the mouth of the Sacramento River at sea-level and have to be lifted by pumping to the elevations of the San Joaquin Valley lands. Before these waters can reach the pumps that would boost them up the grade of the San Joaquin Valley, they would have to cross through the channels of the island region from the lower Sacramento River into the San Joaquin. The ultimate conception of this plan as first laid out requires a barrier below the mouth of the two rivers to divert this water across the delta region without its escape into the sea, or its mingling with the salt waters of Suisun Bay. Studies of the design and cost of this barrier are now in progress that they may be compared with the cost of similar accomplishment by other methods.

Two Plans Studied

Two plans of conveying this water from the mouth of the San Joaquin River up the adverse grade of the San Joaquin Valley floor have been studied. The first method proposed a grand canal 200 miles long into which water could be pumped at its northerly end. This canal would run southward against the grade of the valley on the westerly side of the main river channel in a location selected for smooth topography and easily obtained rights of way. Eight successive lifts would be required along this route to raise the water through a pumping height of 400 feet. This would permit the transportation of the water to the southerly end of the valley floor. Additional pumping would be required from this main canal to reach all the

(*Continued on Page 24*)

*Bulletin No. 4—"Water Resources of California."
Bulletin No. 5—"Flow in California Streams."
Bulletin No. 6—"Irrigation Requirements of California Lands."

†Bulletin No. 9—"Supplemental Report on Water Resources of California."

Don't Forget that Vital Factor *Ground-Water*

Student Technologists in their Schooling, Practicing Engineers in New Developments, Need Specialized Knowledge on this Specialized Aspect of Hydraulics

PART I

HYDE FORBES

By HYDE FORBES
Engineer and Geologist

MUCH space in engineering publications has recently been devoted to discussions of the relative merits of *general* and *special* engineering study presented by the curricula of our universities. The writer's purpose in presenting this article is to obtain, through discussion, the opinion of engineers practicing in the West as to the necessity or advisability of student engineers and geologists of western institutions preparing themselves in the basic or fundamental principles involved in the study of ground water hydrology.

At the present time there is a striking meagreness of definite data relative to many phases of ground water hydrology, and even an uncertainty as to the real applicability of many oft-quoted and widely accepted principles of ground water occurrence and movement. It appears, therefore, that the student, whose study lays the foundation for, and points the way towards, a better understand of the natural phenomena relating to the water beneath the earth's crust, will be in a position at the outset better to cope with physical conditions not generally understood, advance the science, and bring to light, through continued publicity of the results of ground water investigations, much needed information.

GROUND WATER AND IRRIGATION

The widest economic use to which water is being applied in the arid and semi-arid regions is in irrigation. In California alone the increase in irrigated area in the ten-year period from 1909 to 1919 (the latest date for which a census as available) has been about 1,550,000 acres or an increase of about 60 per cent over that irrigated in 1909. Ground water developments have furnished a supply for about one-third of this additional area. That is, prior to 1909 only 350,723 acres were irrigated through ground water development, while that thus served in 1919 totaled 868,060 acres.

The question of ground-water supply for irrigation development is becoming increasingly important in the western states, as the surface water has all been appropriated and is being put to an increasingly beneficial use over larger areas with the agricultural growth of the region. It is usual, in most valleys, that supplies sufficient in quantity for domestic use and stock have been obtained practically everywhere, but when drawn upon for irrigation purposes, these supplies, in some localities, have been found precarious in nature. The demand for irrigation supplies, the ever increasing availability of ground-water because of improved methods of drilling and pumping, and the decrease in pumping costs, and the extensive financial outlay based upon pumped water supplies, have created a need for far more preliminary information as to the magnitude of ground-water supplies, particularly in relation to dependability or to annual recharge, than has been the practice in the past.

The safe yield of an underground basin has been a question seldom considered. It should be investigated and reported upon before money is expended in development. In California many large tracts have been developed into highly productive orchards, vineyards, etc., at great expense through the extraction of the ground water beneath the tracts, only to find that such development has exhausted the ground water supply of the area and that the future existence of the productive area, if it can be saved at all, depends upon the availability of an external source of water supply.

CITIES DEPEND ON GROUND SUPPLIES

Not alone in irrigation activities has the development of ground water as a source of supply been marked, but, especially during the period of deficient rainfall from 1918 through the past year, have the water supplies of most of the smaller towns and many of the larger cities been dependent upon underground sources. The city of Los Angeles drilled about ninety wells along the line of its aqueduct in Owens Valley from which it pumped ground water in quantity to augment its surface supply at that source. A larger proportion of its domestic water supply is derived from ground water sources in the San Fernando Valley and underflow of the Los Angeles River channel. San Francisco is supplied in part from ground water collected by means of a filter gallery in the Sunol and pumped from wells in the Pleasanton Valley. The latter source was more extensively developed and more heavily drawn upon during the dry year of 1924 than has been necessary heretofor. The period of deficient surface flow made necessary the operation of the well fields situated along the eastern shore of San Francisco Bay from Oakland to Alvarado in order that the demand upon the East Bay Water Company could be met.

DISPUTES OFTEN OCCASIONED

These larger developments involve extraction of ground water in such quantities that they are frequently the source of legal disputes. Unfortunately laymen financially interested in ground water developments and engineers who have designed, constructed, and operated such developments, seldom deem it necessary to have a thorough ground-water survey made during the projection of such enterprises. The engineer or geologist frequently finds himself called, however, in the capacity of expert advisor of the Court, or as arbitrator, to investigate and report physical conditions and facts after disputes arise as a result of ground-water developments.

The extraction of ground water due to pumping or infiltration galleries may so lower the water-table as to render neighboring lands less easily cultivated or even unfit for cultivation; cause excessive seepage from neighboring streams or ditches, thus depriving appropriators of the surface water of their rightful proportions of the flow, or cause users

of pumping plants to extend their wells and equipment to greater depth and greatly increase the cost of obtaining their rightful correlative proportion of the ground-water. These interferences have often been brought to the notice of the courts and the law has been defined in relation to the rights of the parties under various conditions through many decisions of the Supreme Court.

Must Find and Present Facts

In general it can be stated that every dispute arising in each locality is subject to the application of certain principles of law, modified by the specific conditions existing in the particular problem. The function of the engineer and geologist in such disputes is to investigate and present the facts in a manner readily understood by the layman and so enlighten the Court and users of water to the end that the ground-water resources will be protected and put to beneficial use to the development of as wide an area as possible. This can only be accomplished by making clear the nature and occurrence of ground-water, its behavior under the conditions obtaining, and the relation between discharge and recharge, to the end that laws will not be established unnecessarily to restrict the use or development of this natural resource, and, at the same time, to conserve it through the restriction of over-development or the deprivation of one locality to the advantage of another.

Again, not only in its development as a water supply is ground water presenting problems, but the spreading of surface water for irrigation purposes over areas of great magnitude, the control of streams through levees, and drainage of delta lands, have greatly modified natural ground water conditions. Irrigation and hydraulic engineers, after rather expensive and disastrous experiences with ground-water accumulations resultant from surface irrigation and excessive ditch seepage, and often from reservoir losses also, are beginning to recognize the necessity for thorough ground-water investigations preliminary to any plans of development or constructive work, and the inclusion in their plans of works designed to meet the changed conditions.

Problem Often Neglected

Generally the accumulation of ground-water and its removal has been considered by drainage engineers to be of relatively little importance in the larger drainage and reclamation projects in comparison with protection from the inroads of surface water during periods of heavy rains and high river stages or the removal of accumulated surface water. In other words the engineer is most concerned with the water which visibly affects the land and whose source is known. However, seepage water derived through downward percolation of stream overflow, levee or channel seepage from streams, direct percolation of rainfall, and the lateral movement of ground-water from porous adjacent and higher lying areas greatly affects the land. This effect may not be manifest as considerable visible amounts of water over any given land surface in any limited time, but, over the area as a whole, it is a most important factor in the reclamation or drainage problem because of the steady accumulation at a constant rate for all time.

In many drainage problems excess water may be due to causes which do not reveal themselves through surface observation as well as does that derived through the flooding of land by surface water, and ground water investigations are always of aid in the problem and the results obtained therefrom almost always justify their expense. Damage frequently results through the excessive application of irrigation water, excessive ditch seepage losses, the backing up of the ground-water through subsurface dams, or leakage from reservoirs, all of which generally cause a water-table rise which may be sufficient in extent to water-log certain lands.

Troublesome Questions Presented

The effect of artificial drainage and irrigation is to change ground-water conditions in a broad way, and such changes are inevitable in agricultural and commercial progress. However, questions do arise in this connection as to whether or not it is permissible for a land owner or group of land owners so to improve his or their holdings as to make them productive to the detriment or ruination of other lands. The drainage of certain lands may be so effected only at the expense of lowering the water-table to such depths under adjoining lands as to render them unprofitable producers or unfit for production.

On the other hand, irrigation may be so wastefully practiced on, or ditches so constructed and maintained over, certain lands as to cause a water-logged condition to prevail, through the accumulation of irrigation return water and ditch seepage, over areas of adjacent lower lying lands. The physical facts pertaining to such questions, corrective measures to be applied in such instances, and the measure of expected damage attributable to certain causes, are questions which should be ascertained through careful investigation before the development is undertaken. It is incumbent upon the investigator to determine the probable modifications due to the projected development, the measure of the modification, as to extent of effect, the cause and its measure, and, if possible, an adjustment through regulation of the cause so that no detrimental effects will result. This is seldom done prior to development but the effect of such developments have presented a variety of problems, both to the courts and engineers responsible for their projection.

This all indicates that the importance of ground-water problems in the agricultural and commercial development of the western and southwestern portions of the United States cannot be over-emphasized. If we are to progress, ground-water as a water supply resource will have to be conserved and developed to a far greater extent in the future.

Big Field for Research

The development of ground-water for water supplies appears to present few difficulties. The existence of this natural resource in abundant quantities is demonstrated by the countless springs issuing from mountain sides and valleys and the multitude of wells found in all settled regions. That water is present in the ground is therefore a matter of common knowledge, but its source, extent, direction and rate of movement, and ultimate disposal are little understood, not only by laymen financially interested in its development, but by most engineers as well, and, while the pumping of water from the ground seems extremely simple, the engineer has encountered many conditions, difficult of solution or impossible for him to solve, before water can be made available for continued pumping as a dependable supply.

This is an era of specialization and it is believed that the present trend of development, with the magnitude and diversity of the questions presented, justifies a specialization in ground-water problems.

Calls for Specialization

The science of ground-water hydrology is a body of organized knowledge collected from the other natural sciences, in its present stage of advancement, and not completely covered by the present academic training of either hydraulic and irrigation engineers or geologists. The engineer or geologist who finds his field broadening to include problems in ground-water hydrology, feels the handicap in the lack of knowledge of the essential basic elements which are controlling in such problems. It is a lengthy process to become qualified in ground-water hydrology through experience alone, and, furthermore, a little knowledge of, and experience in, ground-water hydrology is a dangerous thing, as it leads one to jump at conclusions which may or may not be justified by the facts.

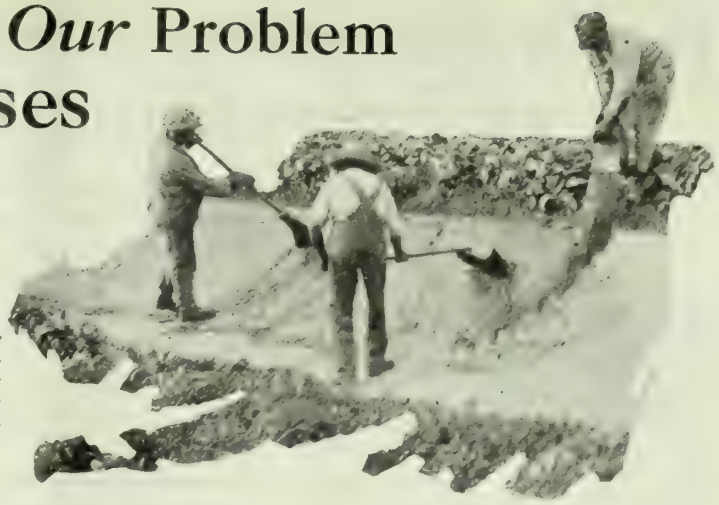
Let us take as an example one problem in ground-water hydrology. It

(*Continued on Page 45*)

How We Conquered *Our* Problem of Leakage Losses

East Contra Costa Irrigation Company Reduces Water Waste By Repairing Ditch Linings With Cold Asphalt

By W. D. SULLIVAN
Manager, East Contra Costa Irrigation Company



Painting the sides of old concrete ditches with the pure asphaltic preparation.

THREE irrigation districts, comprising a total of 20,000 acres of land, are served with water by the East Contra Costa Irrigation Company, an old mutual water company that was formed before the districts themselves were organized under the Wright act. These three districts are known now as the Brentwood, Knightsen and Lone Tree Districts.

As manager of the districts, one of the greatest problems that has occupied my attention has been the high water loss from the canals, particularly in the high main laterals, where the water has to be raised through six stages of pumping to a height of 144 feet from the water level of the river. We use two-stage centrifugal pumps to lift the water, the capacity varying from 13 to 39 second feet, depending on the number of laterals that are to be served.

Large Losses Revealed

It can readily be seen that water, by the time it has traveled a distance of over six miles, and been lifted to a height of 144 feet, represents a comparatively high value per unit of measurement. Carefully kept records, for the year 1925, with its total of 204 actual pumping days, show that over the entire system we have suffered an average loss of almost 30 percent of all water pumped. And on our highest main lateral, a loss of 26 percent is shown.

This loss, occurring, as it does, on a ditch that had been lined about nine years, develops another interesting point that is worthy of consideration when we are discussing the question of linings. Our records, taken on every main lateral of the district, show that the percentage of water lost during the season was as high in ditches where the lining was broken up, as it was in ditches that had never been lined at all.

We were confronted with the necessity of taking some immediate action to correct this loss of valuable water, and we cast about for some method that we might utilize to repair the lining that still retained something like its original form, and to replace it in places where the old lining, laid about nine years ago, had completely disintegrated.

I do not believe the failure of the original lining was due to any one cause, but probably to a number of factors including the carelessness of the contractor who laid it. A two-inch concrete lining had been specified, but in many places the lining showed to be less than an inch in thickness, and broken pieces indicated that a very lean mix had been used.

What we required was some repair material that could be used as a lining, in places where an entirely new lining was needed, as a seal for cracks that had opened and a protective covering for the rest of the ditch.

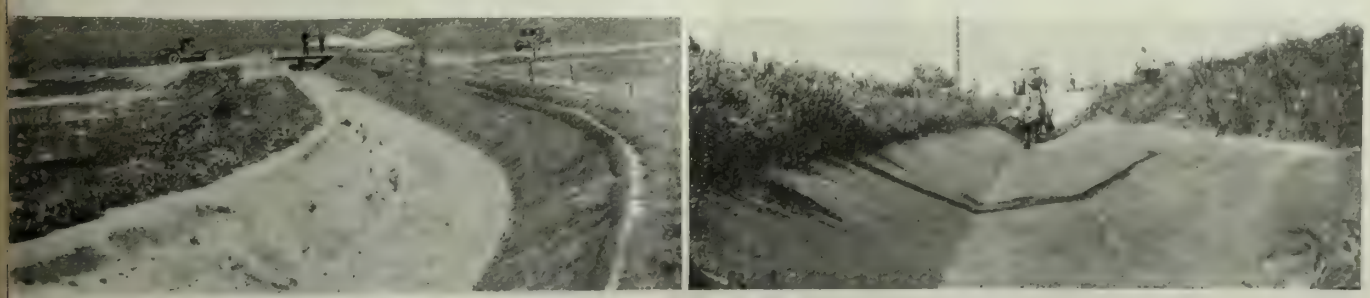
This we found, fortunately, in an emulsified asphalt that can be applied cold,—the trade name in fact is "Laykold,"—and which has been used considerably in this part of the state for repairing asphalt roads. As far as the finished job is concerned, the material looks and appears to stand up just like the more familiar hot mixture used in highway construction.

Experienced Contractor Chosen

This being our first experience with the material, we decided that it would be wise to let the job of applying it to a contractor who is familiar with the product. Malott and Peterson of San Francisco handled the work for us.

They brought one or two men with them, but for the most part were able to use our own men on the job. The material, which comes in barrels was mixed in an ordinary concrete mixer, where an asphaltic mastic was used. Where the preparation was used for painting and patching it was used directly from the barrels, the only mixing being a thorough stirring before it was transferred from the original containers.

The finished job gave us one of the cleanest and neatest looking ditches I have ever seen. At the present time water has been running through this particular lateral for just a few days and as closely as I can estimate, the water loss, which was averaging well over an acre foot per working day, has been reduced until it is now less than 25 percent of that amount. . . . And a large percentage of this loss is due, of course, to pumps running back and to leaky gates.



On the left, the concrete lining, nine years old. On the right, the new asphalt covering.

Is *Cultivation a Fallacy* as a Means of Preventing Evaporation?

Extensive Tests Cast Doubts on Traditional Value of "Mulch" as Conserver of Moisture

By F. J. VIEHMEYER*

THE QUESTION, "What becomes of irrigation water?" might be answered truthfully and in a few words without imparting much useful information. A consideration of the amounts of water lost from the soil in various ways and the importance and relation these amounts bear to the total quantity of water applied to the soil is much more complex.

The disposal of water applied to an orchard can be accounted for in a number of ways which may be listed as follows:

1. Losses in conveyance and run-off at lower ends of furrows or checks.
2. Evaporation losses from the free water surfaces while the water is being applied.
3. Deep percolation below the reach of roots.
4. Seepage losses along impervious strata below the surface.
5. Evaporation directly from the surface of the soil.
6. Water used by the plant.
7. Water remaining in the soil.

All of these losses with the exception of those listed in items 5 and 6 are more or less under the control of the irrigator and may be reduced by skillful methods to almost a negligible amount. However, every orchardist is concerned to know what portion of the total amount of water applied to the soil is used by the plant and how much is wasted by evaporation from the surface of the soil. For this reason the discussion will be limited to this phase of the question.

There is abundant evidence that under humid climatic conditions a large portion of the water from rains which falls on the soil is lost by evaporation. In fact, the records taken from the lysimeter experiments at Rothamstead in England which extend over many years and from similar experiments at Cornell university and elsewhere in this country show that as much as 60 per cent of the rainfall is returned to the atmosphere by evaporation from the surface of the soil. A knowledge of this fact has led many writers to stress the importance of these losses, and the need for controlling them by different kinds of mulches and by cultivation. For example, Hall, who was closely associated with the work at Rothamstead, in his text-book, *The Soil,* emphasizes the losses by evaporation and says that in some soils the capillary rise of water might be as much as 200 feet. Cameron states in his book, *The Soil Solution,* that the larger part of the water from rains in humid areas returns to the surface through distances of many feet. The statement will be found in Widtsoe's book, *Principles of Irrigation Practice,* that there is, soon after each irrigation, a steady upward movement of water, causing a general drying out of the soil to great depths. King in his several text-books and in many reports of the Wisconsin agricultural experiment station, and Hilgard and Longbridge in reports of the California agricultural experiment station, laid great stress on the losses of moisture through evaporation from the soil surface by upward capillary movement.

Of course, a much larger list of such references could be given but these examples are selected because they are more frequently quoted in the literature. There is one vital point to be noted in all of such references, and the one on which, in the opinion of the writer, rests the validity of the argument either pro or con, concerning the importance of evaporation losses and their means of control. This is, whether the losses by evaporation are confined to the surface layers of soil or whether there is an upward capillary movement of moisture from the lower layers and subsequent loss by evaporation. The large losses of moisture from the soil by evaporation in humid climates might be explained by the fact that much of the rain may come

Is Cultivation "the Bunk"?

That cultivation, in so far as it relates to moisture, may be necessary only to kill weeds, and keep the soil in a receptive condition to absorb rainfall, is the conclusion of Prof. Viehmeyer, as the result of the experiments which he describes in this article.

Cultivation, he declares, seems to have little influence in controlling the amount of water evaporated from the bare surface of the soil in the tanks used in the experiments at Mountain View, containing one-half to three-quarters of a ton of soil.

The supposed efficacy of cultivation in controlling evaporation losses is doubtful in any event, he says, since so large a portion of the total water loss occurs before the soil surface is dry enough to cultivate.

Cultivated and uncultivated soil, after exposure to evaporation for four years, without addition of water, retained approximately equal moisture content, and neither had been reduced below the wilting co-efficient except in the upper layers.

Transpiration is a tremendously greater factor in the loss of soil moisture than evaporation from the surface in either cultivated or uncultivated soils, believes the author. "Most of the water applied to the soil occupied by roots remains in the soil until it is taken out by the plant."

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in small amounts which do not penetrate very deeply into the soil. When these light rainfalls occur in the warmer parts of the year the atmospheric evaporating power is high and the soil will quickly dry out. It is clearly evident that almost all of this water may be lost in this way and only that which penetrates deeply into the soil will remain. The situation in the arid and semi-arid regions of the west is quite different. In California the rains come when the atmospheric evaporating power is low and even though the amount of rain over the greater part of the state is light most of it penetrates deeply into the soil. Furthermore, the usual practice is to apply water in sufficient amounts to wet the soil to considerable depths and that part which remains in the surface layer and rapidly evaporates is a relatively small portion of the total amount applied.

What is the Utility of a Mulch?

It will be noted in the references cited that it is believed that losses of water are occasioned by the upward movement of moisture from the lower moist layers of soil and that this belief is based upon the familiar teaching that moisture is capable of moving in the soil in all directions through capillary forces. The part cultivation is supposed to play in preventing the upward rise and consequent loss of moisture into the atmosphere is based upon the theory that by loosening the surface, rapid drying takes place and the soil particles are removed from close contact with one another. The first condition is thought to shut off evaporation because the dry soil is assumed to act as a blanket; the second, reducing the points of contact is believed to lessen the capillary pulling power. A great many references may be cited in support of this basic idea and almost as many in refutation of it. Certainly it is difficult to understand the justification of a statement made in a very recent paper dealing with this subject that "Where the mulch is measured solely as a retentive agent, as under irrigation, the evidence is unanimous that its effect is positive in saving moisture."

The movement of moisture in soils contained in glass or metal cylinders and columns of soils in tanks or metal lined flumes, when the lower ends are in contact with free water has received much study. The movement of moisture from moist soils into soils containing lesser amounts of moisture, the field conditions more frequently met with in California, has received considerably less study. However, the published results of most of such studies indicate, although some of the investigators did not come to this conclusion, that the movement of moisture, especially in an upward direction, from moist soils to drier soils is slight in amount and extent within periods of time with which orchardists are concerned, and when the source of the moisture supply is not saturated soil in contact with a free water surface.

Numerous observations of moisture conditions found by sampling field plots have been reported and, in many cases, the upward movement of moisture by capillary action and evaporation losses have been held to be very important. On the other hand equally good evidence has been advanced that comparatively little water which has passed below the first foot of soil is lost by evaporation and that the loss of moisture takes place largely through transpiration. Sewell, of the Kansas agricultural experiment station, in 1919, published in the *Journal of the American Society of Agronomy* a review of much of the literature dealing with tillage not only in its relation to moisture conservation but also in relation to its other supposed effects on the soil and plants. Sewell concludes "that the prevailing theories advocating deep plowing and frequent cultivation are not founded upon experimental evidence" and that "cultivation may be necessary only to kill weeds and keep the soil in a receptive condition to absorb rainfall." This, in so far as it relates to moisture, is the conclusion reached by the writer from the results of experiments, some of which are presented below.

Tests Determine Losses

At Mountain View, in the Santa Clara Valley, clay loam soils were packed in tanks which contained from one-half to about three-fourths of a ton of soil. The tanks were arranged in trenches and could be conveniently weighed by means of a portable derrick and suspension scales. Water was applied to the surface of the soil in the tanks and as soon as the surfaces were sufficiently dried, some of the tanks were cultivated by stirring the soil to different depths. The soils were thoroughly cultivated every week until the end of the test. In other tanks the soil was undisturbed except to remove any weeds which grew. The losses of moisture in pounds per square foot of surface of soil are given in Table 1. The water was applied to each tank on August 17, 1921, and the results of some of the weighings are given in the table.

Table 1—Average losses of moisture by evaporation in pounds per square foot from the surface of bare clay loam soils, in tanks at Mountain View. Water was applied to soil August 17, 1921.

	August			September					October	November	
Treatment of Soil	25	27	29	2	10	16	24	30	8	1	4
Undisturbed except to pull weeds	4.6	5.0	5.4	6.1	6.8	7.4	7.8	8.4	8.4	9.3	9.4
Cultivated weekly to depth of 6 inches	4.5	5.0	5.4	5.8	7.0	7.2	7.8	8.4	8.4	9.4	9.8
Cultivated weekly to depth of 8 inches	4.8	5.0	5.4	6.0	6.6	7.2	7.6	7.8	8.0	9.3	9.5
Cultivated weekly to depth of 10 inches	4.3	4.9	5.0	5.4	6.0	6.6	7.0	7.3	7.3	8.4	8.7

Table 2—Percentages of moisture in soil in tanks at Mountain View, 80 days after irrigation.

	Depth of Soil Samples in Inches					Depth of Soil Samples in Inches			Average in Depth of
Treatment of soil	0-4	4-8	8-12	12-16	16-20	0-12	12-24	24-36	0-36
Undisturbed except to pull weeds	9.4	15.3	17.7	19.2	19.0	13.9	18.8	18.7	17.0
Cultivated weekly to depth of 6 inches	9.7	18.9	18.9	19.0	20.6	15.3	20.4	20.0	18.8
Cultivated weekly to depth of 8 inches	8.9	15.2	18.2	17.2	19.8	13.0	19.4	17.1	16.8
Cultivated weekly to depth of 10 inches	7.5	14.8	16.9	18.1	17.4	13.0	17.4	18.1	16.5

Table 3—Summary of soil moisture contents in 3-foot depths, in acre inches per acre in the cultivated and uncultivated plots at Davis, irrigated August 2, 1921

Depth of Soil Samples		Aug. 3	Aug. 5	Aug. 8	Aug. 26	Sept. 23
0-3	Cultivated	11.09	9.83	9.50	8.56	8.46
	Uncultivated	11.94	10.44	9.88	9.13	8.33
3-6	Cultivated	8.94	8.38	9.36	8.99	8.52
	Uncultivated	9.59	9.08	8.85	9.03	8.70
0-6	Cultivated	20.03	18.21	18.86	17.55	16.98
	Uncultivated	21.53	19.52	18.73	18.16	17.12

One pound of water per square foot is equivalent to depth of about 3-16 inches. The average losses from the tanks differed approximately by this amount which probably was within the experimental error. The average loss from the uncultivated soils in the 80 days was 9.4 pounds per square foot which also was the average loss from all of the cultivated tanks when they were grouped together without regard to the depth of cultivation. It is apparent, then, that cultivation seems to have little influence in controlling the amount of water evaporated from the bare surface of the soil in the tanks.

It should be noted from the data in Table 1 that the loss which occurred within the first week after the water was applied was approximately one-half of the total loss which occurred within 80 days, a period usually longer than that between irrigations. This rapid loss immediately following irrigation is further illustrated by the records obtained from tanks with bare undisturbed soil exposed to evaporation for the entire summer of 1922. These tanks were irrigated on May 14, with sufficient water to saturate the bottom 6 inches of soil in the tanks. The average loss during the week

following irrigation was 13 pounds. The accumulated loss at the end of the first month was 19 pounds. The total loss for the entire 164 days or from May 14 to Oct. 26, was 33 pounds. The surface of the bare soil in these tanks was undisturbed except to pull weeds. These rapid losses of moisture by evaporation from these loam soils in many instances occurred before the soil could be properly cultivated. It will be seen, then, that the supposed efficacy of cultivation in controlling evaporation losses is doubtful in any event since so large a portion of the total loss for long periods occurs before the surface is dry enough to cultivate.

Four Years' Observation

Several of the tanks were kept under observation for a long time. One of these, containing Yolo clay loam which had an area of 3.01 square feet exposed to evaporation. The tank was irrigated on Aug. 17, 1921, and the surface of the soil was undisturbed except to pull weeds. It was covered during rains to prevent the addition of water after the initial irrigation. The total accumulated loss of moisture at the end of the different periods was as follows: Loss at end of first week, 12 pounds; 6 months, 29 pounds; 12 months, 33 pounds; 18 months, 40 pounds; 24 months, 44 pounds; 36 months, 51 pounds, and at the end of 51 months, 57 pounds. The total loss of 57 pounds which is 18.9 pounds per square foot is equivalent to about 3⅜ inches in depth for a period of over four years. The soil moisture after four years' exposure to evaporation had not been reduced below the wilting coefficient except in the upper layers.

It has been possible to make a number of comparisons between the losses of moisture from cultivated and uncultivated soils in tanks under the atmospheric evaporating condition at Davis, in the Sacramento Valley, as well as at Mountain View. The results have been the same as these obtained at Mountain View in that the losses were substantially the same whether the soil was cultivated or undisturbed. During 1923 and 1924 a sandy loam soil, which was much lighter in texture than any soil previously used, was packed in the tanks. The losses of moisture from the bare soils were determined for a period of 11 months. The average loss during this time was 51 pounds per tank, or 13.8 pounds per square foot of area exposed to evaporation. This loss is greater than that from finer textured soils, clay loams. The evaporation losses observed in field trials also were greater from the sandy soils.

The soils in the tanks at Mountain View, data from which are given in Table 1, were sampled to ascertain the distribution of moisture 80 days after the water was applied. The results are presented in Table 2.

Main Loss from Top Layer

Apparently there is little difference in distribution of moisture in the soil in the cultivated and uncultivated tanks. The majority of the loss seemed to be confined largely to the upper 4 inches of soil. It will be noted that below 8 inches there were very uniform percentages of moisture even 80 days after irrigation. One of the tanks which was under observation for more than four years after the application of water and which was covered during rains was sampled at different times. There was a gradual loss of moisture throughout the entire depth of soil but rate of loss was extremely slow. It can not be assumed that these losses from below the surface layers are due entirely to upward capillary movements or to loss by water vapor movement. It was assumed for many years that the water lost from the soil by water vapor was extremely small and any losses which did occur from the deeper layers was attributed to capillary movement. However, recently evidence has been advanced which seems to show that considerable aeration of soils takes place due to atmospheric pressure changes and it is possible that the slight losses of moisture from the deeper layers of the soil used in these experiments may have been due to movement of air and water vapor through them.

Test Field Losses

Trials with field plots were also made to determine the loss of moisture by evaporation from the soil. The plots were located at Davis, on Yolo loam soil; at Mountain View, on Yolo clay loam; at Delhi, the San Joaquin Valley, on Oakley fine sand, and at Whittier, on Yolo clay. These locations represent a wide range of climatic conditions and the soils differed markedly. At each place four plots were laid out. Each plot was 90 feet long and 20 feet wide, separated by a strip 10 feet wide. The plots were irrigated so that there was an even distribution of water in each and as soon as the surface had dried sufficiently two plots were cultivated and the surface of the soil in the other two plots was undisturbed except to pull weeds. The cultivated plots were thoroughly cultivated at weekly intervals throughout the period of the test.

A summary of the moisture contents in the plots at Davis are given in Table 3.

Some of the results of sampling the plots at Whittier are given in Table 4. The results of all of the field plot studies indicate that no loss of moisture occurred from the soil in the depth of 3 to 6 feet. Sampling in depths of one foot at Davis, further show that the losses were confined almost entirely to the upper foot of soil. Samples taken in depths of four inches approximately two months after the water was applied in the field plots likewise clearly show that the losses of moisture by evaporation occurred largely in the upper eight inches of soil and the greater portion of the loss from this depth was from the first four inches.

The data presented in Tables 3 and 4 are typical of the results obtained in all of the field plot trials. Some of the tests were run for longer periods and were repeated. The results show that the loss of moisture by evaporation from the surface of the soil under California conditions is not very great and that cultivation did not influence the amount of water lost or the distribution of moisture in the soil.

Plants Grow After 80 Days

The presence of relatively large amounts of water in the clay loam soils in the tanks which have been described, even after long exposure to evaporation, has been demonstrated. Sixteen of 20 tanks which had been irrigated August 17, 1921, were planted to vetch and barley after having been exposed to evaporation for 80 days. The upper four inches of soil was too dry to germinate the seeds which were planted on November 4. Therefore, a small amount of water (less than one-half gallon) was added to start the seeds. The plants were thinned after they were up so that there was a definite number of plants in each tank which gave a stand comparable to that usually obtained in an orchard cover crop. Satisfactory crops were produced in each tank. During rains the tanks were covered by means of a canvas drawn over a frame. The loss of moisture by evaporation during 80 days previous to planting the seeds had not been sufficient to prohibit the maturing of cover crops. There seemed

(*Continued on Page 32*)

Table 4—Summary of the soil moisture contents in 3-foot depths, in acre inches per acre in the cultivated and uncultivated plots at Whittier, 1921 Irrigated July 15, 1921.

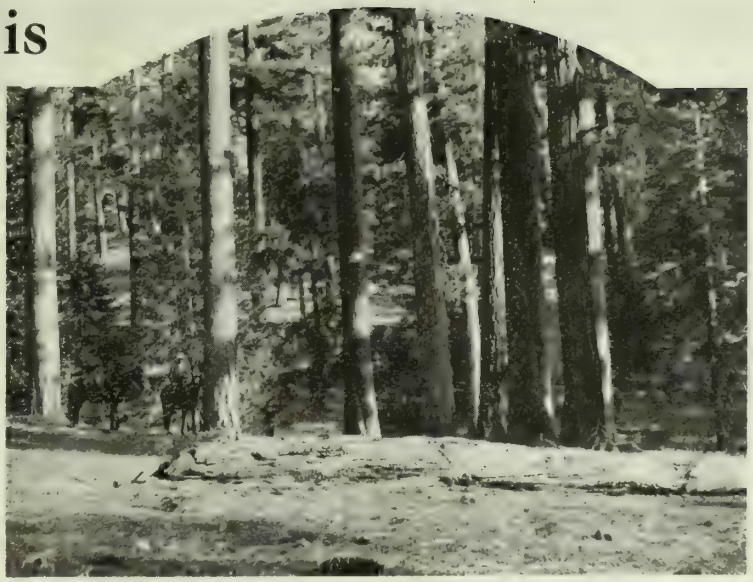
Depth of Soil Samples		July 21	Aug. 4	Aug. 18	Sept. 3	Sept. 30
0-3	Cultivated	9.59	8.98	8.55	9.09	8.82
	Uncultivated	9.98	9.09	8.71	9.09	8.60
3-6	Cultivated	8.49	8.54	8.21	8.38	8.32
	Uncultivated	7.93	7.93	7.88	7.99	8.05
0-6	Cultivated	18.08	17.52	16.76	17.47	17.14
	Uncultivated	17.91	17.12	16.59	17.08	16.65

Public *Knowledge* is the *Forests'* Need

Advertising Clubs of the World, Through Committee on Reforestation, Assist in Spreading Information

By MALCOLM MUIR

Chairman of the Reforestation Committee of the Associated Advertising Clubs of the World.



Virgin forest, of the type fast dying out in the United States. (Photo by U. S. Forest Service.)

BELIEVING that the greatest single need to solve the problem of reforestation is a realization, by the entire population of the United States, of the magnitude and importance of the emergency, and the necessity for drastic action, the Reforestation Committee of the Associated Advertising Clubs of the World is co-operating closely with the National Forestry Committee to arouse that public interest which is so essential to the problem's solution.

This year, in addition to spreading the gospel of reforestation throughout advertising organizations all over the nation, the reforestation committee is encouraging members of advertising clubs in all parts of the country to co-operate in actually planting trees, thus setting a practical example, which, it is hoped, will be followed by other organizations actively interested in the national welfare.

Agriculture Depends on the Forests

The Associated Advertising Clubs of the World recognize that a question of rehabilitating our forest resources involves a great deal more than merely conserving materials for building houses, making paper, and for the many other purposes for which forest products are used. On forest conservation depends, to a large extent, the success of the basic industry of the United States—agriculture.

Picture the millions of hillsides of the country as covered with sponges, which, during the rainy season, become filled with water which is retained as in a gigantic reservoir and released gradually during a drought. Such a picture presents the function of our vast forests in aiding agriculture in a way that can never be adequately supplanted by any other agency.

Open the pages of history of those countries which have ruthlessly destroyed their forest resources, and you will find that the most glaring example undoubtedly is that of China. With no thought to the future, the Chinese people were permitted practically to denude the entire country, and China's backward position among the nations of the world, the frequent famines, and comparative destitution, are largely due, economists say, to its forestry situation.

The United States Forestry Bureau goes so far as to place the conservation of water supply as the most important function of the National Forest. In the report on government forest work the forestry service says, "Undoubtedly the greatest value of the mountain ranges in the country, most of which are within National Forests, lies in their influence upon the regularity of the water supply. In many of the states the mountains afford the main water supply for domestic use, for irrigation, and for the development of power. The future development of the entire country, therefore, will depend upon the amount of water and the manner in which it flows from the mountains."

Pacific Coast Has One-Half Timber

The extent of the cutting out of our original forests in the United States may be understood when it is said that less than five per cent of the virgin forests of New England and but twelve per cent of her original stand of timber now remain. New York, a leading state in lumber production in 1850, now manufactures only 30 board feet per capita yearly, or not more than a tenth of the requirements of her own population and industry. The original pine forests of the Lake States, estimated at 350 billion feet, are now reduced to less than eight billion. One half of the timber remaining in the continental United States is in three states bordering the Pacific Ocean.

The vegetable covering has a very decided influence on run-off. For this reason Congress made the preservation of conditions favorable to stream flow one of the principal objects in the establishment and administration of the National Forest. Many communities have entered into cooperative agreements with the Forest Service for the better protection of the water-sheds from which they get their supplies.

Rainfall is not so rapidly evaporated or drained off in forest regions, the moisture gets into the soil there, and the force of the wind is broken. Consequently, a forest country avoids much of the seasonal aridity that marks an open country with an equal amount of rainfall. The removal of the forests has thus emphasized climatic effect in some countries resulting in their virtual sterilization. In addition to China, Spain, Siberia, Algeria and North Africa are commonly cited as illustrations of countries whose productiveness has been reduced by the denudation of the forests.

President Coolidge, addressing the first conference on the utilization of forests, said, "Fully one-fourth of our land area ought to be kept in forests—not poor, dwindling thickets of shrub, but forests of trees fit for bridges, houses and ships. Idle forest land has scrapped schools, factories, railroads and towns; it has dotted the land with abandoned farms, it has created a migratory population. Our forest problem is a land problem of the first magnitude."

Drastic Action Necessary

Since the depletion of our forests has not resulted primarily from a practical

(*Continued on Page 29*)

The EDITORIAL

MODERN Irrigation

An Organized Voice for the Forces of Agriculture and Industry Which are Primarily Dependent upon Irrigation.

Published Once a Month
AT LOS ANGELES, CALIFORNIA, BY THE
PETROLEUM WORLD PUBLISHING CO. *Editorial and Executive Offices, 626 South Spring Street, Telephone Broadway 3262.* Branches: SAN FRANCISCO—447 SUTTER STREET, *Telephone Garfield 2772;* H. E. TAYLOR, *Manager.* CHICAGO—1163 MONADNOCK BLDG., *Telephone Wabash 8855;* JOSEPH E. O'CONNOR, *Manager.* NEW YORK,—56 W. 45TH STREET, ROOM 1105, *Telephone Vanderbilt 3672;* WERNER HAUPTLI, *Manager.*

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By Annual Subscription in the United States and possessions, $2.00; Foreign, $2.50; Single copies on sale in the irrigation country, 20 cents. In ordering change of address, give both the old and the new address. Allow ten days for re-entries on the subscription list. Advertising rates and circulation data upon request. Checks should be made payable to Petroleum World Publishing Co.

Vol. II MAY, 1926 No. 5

A Vital Interest

SECRETARY WORK, in prefacing his Los Angeles address on the question of the Colorado River developments, said: "I have come to the West to meet and talk with its representative people, and because I believe that I have something important to say to them."

The audiences that greeted him in Los Angeles and San Francisco left no doubt in his mind as to the importance which they, also, attached to his message. In the gatherings which he addressed there were those who agreed with him heartily and those who were doubtful of the wisdom of the commitments which he has made. But there was no division on the question of the importance of the whole matter.

Every state that is to share in the distribution of the Colorado's much needed waters, every individual or corporation that has taken a stand either for or against any projected plan of development, should, for self-interest if not for the welfare of the entire southland, be deeply anxious for an immediate settlement upon some plan of operation that will break the impasse which has existed for so many years.

Dr. Work's remarks, whether one agrees with all of them or not, are of the utmost importance because they point in the direction of definite progress toward a possible use of the River that is now wasting a large part of its value.

Will Congress Act?

ALTHOUGH the favorable report of the senate committee was undeniably a victory for the proponents of the Swing-Johnson measure, it by no means settles the question. As a matter of fact there is little chance, if any, of congressional action before adjournment in June.

The prospect seems favorable for some action by the House Committee after Congress re-convenes, and when the measure is brought to the floor of the two houses, there will be an opportunity to find out what its chances for success actually are. It still has obstacles to overcome. The westerners who comprise the irrigation committees are naturally more prone to give favorable consideration to such a measure than the representatives of eastern and southern states whose attitude toward reclamation is often extremely skeptical.

Whatever is the outcome, the rate of all reclamation and irrigation progress ought to be materially accelerated by definite action. Secretary Work broadly suggested that government construction and operation was not the only way out, that government supervision was an essential, but that some "organized corporation" might possibly be able to advance plans for the construction of the proposed works under private auspices that would deserve sympathetic consideration.

If the waters of the Colorado can not be made to yield their potential worth to the west under one plan, they should be made to do it under another. The essential thing is to get action. Public opinion in the west, at least, seems to be pretty much convinced of that, and a decision within the next year seems now to be definitely possible.

Freakish Finance

A CONTRIBUTOR to this issue points out that there must be something wrong in the attitude of the investing public toward irrigation values, to judge from the relative quotations on municipal security issues of cities compared with those of irrigation districts. As an instance he points out that bonds of the City of Merced, California, are being sold on a basis that yields 4.40 per cent to the investor, while in the same market bonds of the Merced Irrigation District yield almost six per cent.

In other words, it costs more to finance irrigation developments than it does to float security issues of other forms of municipal enterprises, and in this case the comparison is made doubly effective by the fact that the Merced Irrigation District includes the city of Merced, and in addition about 180,000 acres of valuable irrigable land.

His point is that the investor has been deluded by a fiction of danger that has surrounded irrigation securities. Whether this fiction has been artificially created or has grown up naturally out of the

POINT *Of* VIEW

checkered history that has occasionally attended investments in irrigation securities, it is nevertheless a fact, and it is the responsibility of the irrigation industry to dispell it.

Irrigation has had its failures and its insolvencies, as has every other industry. But that is no reason why districts with everything in their favor from a business standpoint should be penalized in their financing operations.

The Value of a Tree

IN ANOTHER part of this issue, a contributor tells something of what is being done by a committee of the Associated Advertising Clubs of the World in the way of disseminating information and creating a wider public interest in the problem of reforestation. In undertaking this work, the advertising men have embarked upon a splendid enterprise.

Their immediate interest, of course, is in conserving the most vital raw material that is used by their profession. In a sense, their concern in the preservation and restoration of the forests is selfish, but, in a larger sense, it is a generous and patriotic move for the welfare of the whole people.

All of us, indeed, are interested in reforestation from a motive that is selfish in the last analysis. But it is a fortunate thing when we can, in advancing a movement which has such a vital tie-up with our own necessities, also contribute to the best interests of the whole nation, and help to conserve a great economic, social and aesthetic resource.

The Fire Menace

WE ARE hearing a great deal about reforestation lately, but not so much about the 50,000 acres of land that are cut over each year by private logging operations, forty per cent of which are left in an unproductive condition. There are one and a quarter million acres of waste or brush land in California alone that are not producing anywhere near the crop of timber that they should. These lands are the result of two factors that constitute a grave menace—improper lumbering methods and repeated forest fires.

Many of these acres will have to be reforested. But what about the acres that are being cut-over this year, and will be cut-over next year? The solution to this problem depends upon the lumbermen leaving seed trees, protecting young growth and excluding fire from cut-over areas.

Reforestation is a big national problem, but in the far west it is secondary to fire prevention, for in the high mountains of the Pacific Coast, nature will attend to reforestation if given a fair chance. In the redwood region, planting is of course necessary, since clear cutting of the stand is practiced.

The trouble is that nature is not given a fair chance. The careless campfire, and the deadly cigarette, are still destructive in spite of the careful work that is being done by the protectors of the forests.

How About Cultivation?

PROFESSOR VIEHMEYER'S article, a republication of a paper presented to California citrus growers recently, will undoubtedly elicit a good deal of interest from readers of this magazine. There is no axiom of agriculture more widely accepted than that irrigated land should be cultivated, as soon after the application of the water as it is possible to get on the land, in order to prevent the evaporation of the moisture which has been introduced at such cost of time, effort and money. Professor Viehmeyer's experiments would indicate that this impression is an unscientific one.

In his article he is satisfied with presenting the results of his experiments, without making the "inductive leap" that would generalize too broadly from the particular data adduced, and merely suggesting the obvious inferences which his surprising results seem to justify. He has not tried to say the last word on the subject, and that last word will probably not be said for a long time. He has, however, opened up for discussion a problem of great practical interest to every irrigator. Whether cultivation is as effective as a preventive of evaporation as is generally conceived, or whether it is as negligible as his laboratory experiments seem to indicate (for most of the experiments were on a laboratory scale); or whether its value lies between these two extremes, the practice of irrigation will be well served by approaching the problem from the scientific standpoint, and finding out actually what occurs, and exactly what the value of cultivation is, not only as a moisture control, but in every other way in which it serves the farmer.

Walla Walla Responds

THE BURBANK and Attalia irrigation districts, in Washington, have been hard pressed to meet their financial obligations. Recently it looked as though the families living on the projects—104 of them—would have to surrender their holdings and move away. Warrants were five or six years behind. The water was to be shut off if payments were not made. Only a few thousand dollars were needed to meet the temporary emergency, but these few thousands seemed as far away as so many millions.

Representatives of the two districts appeared before the Walla Walla Chamber of Commerce at its meeting on April 13, and told their story in a matter-of-fact way. Before the meeting had adjourned, the business men of that city had subscribed the needed thousands, and the funds for tiding over another year were assured. The Northern Pacific Railway led the subscription list with a pledge of $1000.

It was a generous thing, but if, as is probable, the districts may be rehabilitated, the families saved to the Walla Walla region, and the 2500 irrigated acres prevented from reverting to a desert condition, it was a wise thing, as well.

San Joaquin River to be Turned Upside Down

(Continued from page 14)

lands that could be so irrigated, for the bulk of these lands lie from three hundred to six hundred feet above sea-level.

Further study has evolved a superior plan that would employ the channel of the San Joaquin River as a conduit. Instead of excavating a huge canal on the west side of the valley, the present river channel would be utilized by placing low dams with adjacent pumping plants, at intervals along its entire length. The dams would form a series of ponds in the river channel each nine to eighteen miles long and each successively about ten feet higher than the one before. The pumps at each dam would boost the water from the lower to the higher levels. Fourteen such dams would carry the water one hundred fifty-four miles southward against the grade of the valley floor to the mouth of Fresno Slough. The average static lift at each dam would be 11.3 feet and the entire series would raise the water one hundred and fifty-nine feet above sea level. This series could be extended southward in Fresno Slough for sixty miles further. Southward from here, through the Tulare Lake basin, a canal would have to be excavated since there is no suitable natural channel in this section of the valley floor.

To Run Up the San Joaquin

This method of employing the San Joaquin River channel as a conduit for boosting the Sacramento water up the grade of the San Joaquin Valley floor, would cost less than half as much as the grand canal of the first method and would furnish a much more flexible system of works for progressive development. Also it would promote the conservation of water, for these dams would stop all unused water in the tributaries of the San Joaquin from running to waste; the maintenance and operation costs would be much less than those of a grand canal and a very serious objection to the grand canal, that would become of increasing importance as the San Joaquin Valley becomes more thickly populated, would be overcome. This objection is the creation of a new obstacle to communication and traffic on the valley floor. A grand canal of dimensions sufficient to carry the large volume of necessary water would create an unbroken obstacle to traffic through the entire length of the valley and divide the valley floor into three long strips of land instead of two. The employment of the present river channel creates no new obstacle to communication and saves for future use very considerable areas of rights of way that would be occupied by a grand canal. Also, if it should become desirable, such a series of dams could be adapted to the employment of the river for navigation. At the present time there is practically no navigation on the San Joaquin River except in its lower reaches. By constructing locks at each one of the dams the river could be made navigable the year round.

Economy to Be Served

Since the bulk of the lands of the San Joaquin Valley needing an outside source of supply lie at elevations of more than two hundred feet above sea-level, a heavy pumping charge would be entailed if the Sacramento River water were pumped directly onto these lands. It is found that this can be avoided to a large extent by pumping the Sacramento River waters onto the lower lying lands in the San Joaquin Valley that are now irrigated from San Joaquin River waters. By serving these lower lands from the Sacramento River, the equivalent amount of waters served them could be diverted southward by gravity from the high elevation on the valley rim at which the San Joaquin River emerges from the mountains. Irrigation on the lower lands in receiving the equivalent to their customary supply would not be affected by the exchange. Studies of a first unit of such a plan for importation of Sacramento waters into the San Joaquin show that three hundred and forty feet in pumping lift could be saved by effecting such exchanges in supplies.

Map Illustrates Plan

The accompanying map (page 13) shows the outlines of the plan for such a first unit. Four great foothill reservoirs on tributaries of the Sacramento River are indicated, either of which might be used for storing surplus waters in the Sacramento Valley. There are also other reservoirs that would be serviceable for the same purpose. The general location of the series of dams in the San Joaquin River is indicated on the map. These dams would keep the channel of the San Joaquin River filled with water for the entire distance and the projects now diverting water from this channel would receive water supplied by the pumping plants boosting from one pond to the other, while the natural flow of the San Joaquin River would be diverted southward at a high elevation near the Friant Reservoir.

The canal carrying the San Joaquin water southward passes through an area now irrigated from the Kings River. By serving this territory with San Joaquin water and diverting the Kings River water at the high elevation of the Pine Flat Reservoir, a gravity canal can be run southward to a point two hundred miles into the San Joaquin Valley. Thus by providing a system of exchange of waters that would fully protect present users in the San Joaquin Valley, a new supply could be carried two hundred miles into the San Joaquin Valley to lands lying from two hundred and fifty to three hundred and fifty feet above sea-level with a static pumping lift of one hundred and sixty feet or less.

In describing this plan in a report to the 1925 Legislature it was stated "the studies reveal that only by completely co-ordinating the development and use of waters in both the Sacramento and San Joaquin Valleys can these plans be successfully and economically carried out." Responding to the recommendations in this report, the Legislature appropriated additional sums for developing the facts necessary for maturing final recommendations. These studies are now in progress.

Fundamentals of Management

(*Continued from Page 12*)

and Treasurers, being elective officers, sometimes offer more or less delicate problems in the supervision of their offices but the executive should remember that, after all, the directors are really responsible for all district affairs and with their support and through judicious co-operation all such matters can generally be resolved to reasonable substantial and effective business routine. The reconciliations of all accounts through the Secretary's office and the executive's contact with the auditor's activities generally afford substantial assistance in these matters.

One of the important duties of an executive is that of preparing the budgets for district expense. There seems to be but little excuse for material mistakes in such an effort and through such budget data and adequate valuation data, for assessment purposes, the directors can be assured that their tax levies are fully justified and sufficient.

The foregoing ideas follow closely the procedure exacted by any substantial corporation. If district executives proceed generally thus to discharge their responsibilities they will not only develop a measure of satisfaction to themselves but will gain the confidence and energetic support of all responsible employees, will receive generous and helpful support and guidance from their board of directors and, as a rule, may anticipate much helpful co-operation among the water users.

THE HYDRAULIC DIGEST

A Monthly Bulletin Board of Brief Facts and Events from Far and Near

Pacheco May Build System

Pacheco, California, one of the oldest towns in Contra Costa County, is planning to construct a city water system. Private systems now supply most of the residents, but are proving inadequate.

Pipe Comes from Alabama

Fifteen thousand feet of water-pipe has been shipped from Birmingham, Alabama, for use in Bellingham, Washington, which is making extensive improvements in its water system. The pipe order involved a cost of $40,000.

Orange Will Vote May 19

Faced by an impending water shortage, the city of Orange, California, has called a special election for May 19, at which a proposal to issue $125,000 in bonds for the improvement of the city's water system will be submitted to the electors.

Chelan Growers to Organize

Farmers in the Chelan (Washington) region have presented a petition asking for permission to form an irrigation district to be known as the Chelan River Irrigation District. About 600 acres wll be included. Twenty-eight petitioners are represented.

To Vote $91,000 Bonds

The board of directors of the newly formed Ramona Irrigation District (California) in response to a petition from land-owners, asking for a bond election at which $91,000 in bonds will be submitted to a vote to provide funds for the construction of works for the district, have set May 4 as the date for the election.

Bids Invited on Big Job

Bids on construction contracts which will probably total about $800,000 have been called for by the Nevada (California) Irrigation District, one the basis of specifications adopted by the district. The work to be contracted ranges from building a four-mile 60,000-volt power line to clearing land and building cottages. Metal and wooden flume construction is a feature. Bids will be opened early in May.

Establish Morro Water District

Supervisors of San Luis Obispo County, California, have established the Morro Water District, comprised by Morro and Morro Heights, and in May will set the date for an election at which the matter of organizing such a district will be submitted to the voters within its limits.

Will Reclaim 2,000 Acres

Two thousand acres of tide-land at the mouth of the Chinook River, Washington, will be reclaimed as the result of a decision of the federal War Department to allow the construction of a dike across the mouth of the river. A dike 1,000 feet in length will exclude tidewater and the channel of the river will carry off its normal flow.

Reduce Whitestone Project

The Whitestone (Washington) Irrigation District, has been reduced to include only 2500 acres, and the landowners will meet a construction charge of $100 per acre. The district will issue $250,000 in bonds, which will be accepted by the state in full settlement of the district's obligations. The cost of the project was $750,000.

Director's Seat Threatened

Suit was filed in April—and subsequently dismissed—seeking to remove W. O. Blair of Calipatria from his post as director of the Imperial Irrigation District. The abortive action was predicated on a decision rendered a year ago by the Superior Court, and appealed by Mr. Blair, by which his opponents claim that the director's seat was legally awarded to Mack Trentham.

Submits $17,000,000 Program

Supervisors of the city and county of San Francisco are studying a proposal submitted by M. M. O'Shaunessy, city engineer, providing for a $17,000,000 water improvement program, to extend over several years. The most pressing need included in the program is the purchase of 74 acres of land needed for the Glen Park reservoir, and the creation of 500,000,000 gallons storage capacity by construction of the reservoir.

Outline Deer Creek District

Plans for the formation of Deer Creek Irrigation District, in Tehama County, California, are outlined in a petition presented by property owners to the county supervisors. Thirteen land owners join in the petition. Water for irrigation will be obtained by diversion from Deer Creek and tributaries.

Plan $12,000,000 Project

Plans submitted to the Moorpark-Conejo Irrigation District, in Ventura County, California, by Edward R. Bowen, Engineer, estimate the cost of the proposed irrigation system at $2,316,000 and recommend it as feasible from an engineering standpoint. The plans involve diversion from the waters of Sespe Creek, and the estimate includes the cost of a distributing system within the district.

Water in Hetch-Hetchy Line

Water is now running for the first time through the transbay pipe line of the San Francisco Hetch-Hetchy project. It is not Hetch-Hetchy water, however. The pipe is being used temporarily by the Spring Valley Water Company under the terms of the option agreement by which San Francisco may purchase the system when the Hetch-Hetchy project is completed. The submarine section of the bay line is 2700 feet long.

Farmers Operate Boise Project

The transfer of the operation and maintenance of the Boise (Idaho) Reclamation project to its water users has been practically completed, it has been announced by the Interior Department. The Boise project is the first large federal project to be turned over the farmers for operation in accordance with the new reclamation law. Operation will be under management of a board of central control composed of representatives of the three districts which have entered into a contract with the government for assuming the responsibility of the project's management.

HYDRAULIC ENGINEERING

Dealing with the Practical Problems of the Operating and the Consulting Engineer

Agricultural Engineers Gather as California's Guests at Lake Tahoe, June 23 to 26

SEVERAL HUNDRED of the most prominent agricultural engineers of the United States, coming from every corner of the country, will gather in convention in California next month, when the American Society of Agricultural Engineers holds its annual meeting at Lake Tahoe, June 23 to 26.

The Lake Tahoe meeting will be the first meeting of the organization to be held in California, and it is accordingly creating much interest, both in California, where Pacific Coast members are planning in large numbers to avail themselves of the unusual opportunity presented, and throughout the United States, where the fame of Lake Tahoe and the prospect of a visit to the Golden State, added to the attraction of the annual sessions of the society, combine in an almost irresistible appeal.

Professor L. J. Fletcher, head of the Division of Agricultural Engineering, College of Agriculture, University of California, who is Chairman of the Meetings Committee of the Society, is arranging the program for the Tahoe gathering, in conjunction with the chairmen of the five main divisions of the organization. The preliminary outline of the program includes an array of practical discussions and reports, and a schedule of entertainment, that will intensify the desire of agricultural engineers to be present. All sessions are to be open to everyone interested, regardless of membership in the Society.

Inspection Trips for Visitors

Several hundred delegates are expected from outside of the state. These visitors will be especially interested in California accomplishments in irrigation, reclamation and electrical development. Accordingly, the Pacific Coast Section of the Society, which has the meeting in charge, has arranged three major field inspection trips to show typical examples of these features of California engineering development. These trips will follow the close of the convention at Tahoe and will extend through four days. They will be in general charge of Professor S. H. Beckett of the Division of Irrigation Investigations and Practice of the College of Agriculture, University of California, assisted by other members of the Society.

On Monday, June 28, the delegates will be the guests of the Pacific Gas and Electric Company during an inspection of the hydro-electric and irrigation systems of that company in Placer County, including Lake Spaulding, Drum Power House, and the foothill orchard areas about Auburn and neighboring towns. Leaving Sacramento early Tuesday morning, June 29, the entire party will be given apportunity for an all-day automobile trip over portions of the irrigated and reclaimed areas on both sides of Sacramento Valley, reaching as far north as Durham and Orland. Wednesday, June 30, the Sacramento and Stockton Chamber of Commerce will join the California Delta Farms Company and the Holland Land Company as hosts on a river trip from Sacramento to Stockton with frequent stops at points of especial interest to the visitors. Thursday, July 1, the party will drive by automobile through Modesto and Turlock Irrigation Districts, giving particular attention to irrigation, drainage by pumping, and farm electrification, the latter being one of the chief interests of Society members throughout the country.

Professor Fletcher has supplied MODERN IRRIGATION with the following tentative draft of the program for the meeting:

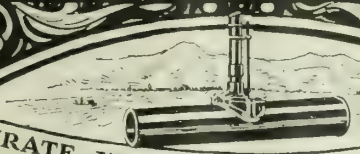
Preliminary Program Draft

Wednesday, June 23, Morning—Reception and registration of members and guests; Special meetings and conferences on Relation of Electricity to Agriculture and Land Clearing. Afternoon—General Session; Address by F. A. Wirt, President of the Society; Papers by J. B. Davidson, Iowa State College, in charge of National Farm Equipment Research, and J. D. Long, University of California. Evening—General Sessions of Farm Structures and Rural Electric Divisions. Papers by Miss Greta Gray, University of Nebraska; Max E. Cook, California Redwood Association; W. G. Kaiser, Portland Cement Association; A. W. Turner, Iowa State College, and W. G. Ward, Kansas Agricultural College.

Thursday, June 24, Morning—General Session; Papers by L. S. Wing, Engineer, California Farm Bureau Federation, and C. D. Kinsman, Division of Agricultural Engineering, U. S. Department of Agriculture. Afternoon—Steamboat trip around Lake Tahoe. Evening—General business session.

Friday, June 25, Morning—General Session. Papers by Professor F. J. Viehmeyer, Division of Irrigation Investigations and Practice, College of Agriculture, University of California; J. V. Mendenhall, President California Delta Farms Company; George Kreutzer, Director of Reclamation Economics, U. S. Bureau of Reclamation; and Major O. V. P. Stout, Division of Agricultural Engineering, U. S. Department of Agriculture, and Chairman Reclamation Division, American Society of Agricultural Engineers. Afternoon—General Sessions of Farm Power and Machinery and Reclamation Divisions, with papers by Professor C. O. Reed, Ohio State University; Professor E. J. Stirniman, Division of Agricultural Engineering, College of Agriculture, University of California; E. V. Collins, Iowa State College; Professor C. C. Johnson, Washington State Agricultural College, and others. Evening—Banquet.

Saturday, June 26, Morning—General Session, College Division, with Seminar in Teaching Methods, led by Professor C. O. Reed, Ohio State University; Discussion of Improvement in Research Projects, led by Professor M.



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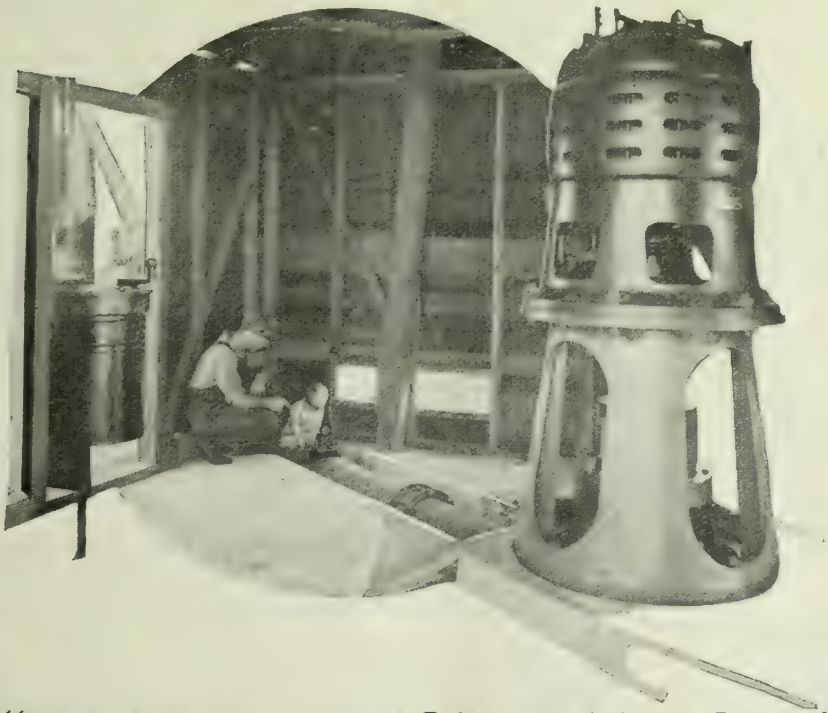

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L. Nichols, Alabama Polytechnic Institute, and R. W. Trullinger, Office of Experiment Stations, U. S. Department of Agriculture; Discussion of Relation of Agricultural Engineering Departments to Smith-Hughes teachers of agriculture, led by Professor E. W. Lehman, University of Illinois; Paper on Results of Co-operation with Implement and Electrical Industries, by Professor H. B. Walker, Kansas State Agricultural College. Afternoon—College Division Extension Program. Afternoon and Evening—Mountain trips and barbecue.

Monday, June 28, to Thursday, July 1—Inspection trips.

Large Attendance Assured

Preliminary information already in the hands of the Pacific Coast Section of the Society indicates that there will be a large attendance both at the main convention at Tahoe and on the inspection trips. The Pacific Coast Section includes in its membership men interested in every phase of agricultural engineering. The present officers of the Section are Frank Adams, Professor of Irrigation Investigations and Practice, College of Agriculture, University of California, chairman; Max E. Cook, California Redwood Association, Vice-Chairman; L. J. Fletcher, Associate Professor of Agricultural Engineering, College of Agriculture, University of California, Secretary-Treasurer. Professor H. A. Wadsworth, of the Division of Irrigation Investigations and Practice, College of Agriculture, is General Chairman of the Arrangements Committee, with particular features of the arrangements in charge of Professor S. H. Beckett, of the Division of Irrigation Investigations and Practice, College of Agriculture; Professors Charles F. Shaw and W. W. Weir, Division of Soil Technology, College of Agriculture; Professors Ben D. Moses, A. H. Hoffman, and E. J. Stirniman and J. D. Long and H. L. Belton, Division of Agricultural Engineering, College of Agriculture; W. W. McLaughlin and Major O. V. P. Stout, Division of Agricultural Engineering, U. S. Department of Agriculture; Max E. Cook, California Redwood Association; P. E. Holt and A. E. Loder, Caterpillar Tractor Company; Walter E. Packard, Land Department, Western States Life Insurance Company; David Weeks, Division of Rural Institutions, College of Agriculture, University of California; Leslie W. Symmes, San Francisco, and M. E. Klein, California Delta Farms, Stockton, and F. J. Southerland, Pacific Gas and Electric Company, San Francisco.

Improved Control on Draglines Found to Increase Capacity

WHAT effect does the factor of stiff control of draglines and shovels have on the efficiency of operation and the capacity of the machine? This is a question in which all operators of such machines are interested, and on account of this interest, considerable attention has been attracted to the results obtained in a recent test conducted in San Francisco, in which similar machines, with and without special equipment for easier clutch control, were tested side by side, engaged in the same sort of work.

J. P. Holland of San Francisco, builder of the skyline Boulevard, and a well-known contractor in the bay region, conducted the test. He operates three Northwest draglines, the oldest of which is not equipped with the "feather-touch" clutch control which was brought out a year ago by the Northwest Engineering Company. The other two machines are equipped with this device. Careful comparisons were made of the results obtained from the new machines and the old one, on the same contract and doing the same kind of work.

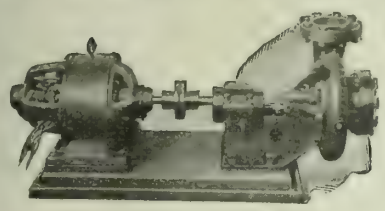
Mr. Holland reported that the machine equipped with the special clutch-control had done just twenty-five per cent more work than the machine that did not have this device. The manufacturers of the "feather-touch control" point to this as a direct and tangible result of easier operation, showing that ease of control plays a large part in the moving of materials. The assertion is made that the new machines, so equipped, eliminate eighty percent of the physical effort ordinarily required for shifting clutches.

The operation of the special control is explained as follows:

"Throwing the bucket, the common practice of fast operators, is more easily and more accurately accomplished. The bucket is instantly and easily retrieved from the ditch without any delays caused by fighting with stiff clutches. The result is, of course, more feet of ditch per day.

"The 'feather-touch' clutch control is a simple device which utilizes the power of the engine. Unlike a steam or air ram which necessarily must be all in or all out, the 'feather-touch' control retains the 'feel' of the bucket and also eliminates air tanks and compressors. By means of a small auxiliary drum on the main drum shaft and a band which is tightened on this drum by toggling connected with the operator's

GOULDS PUMPS



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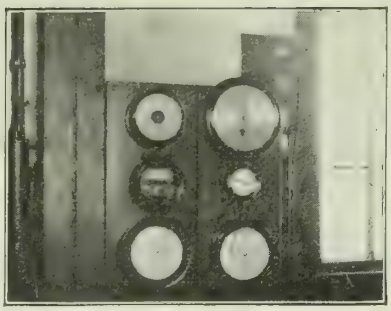
Knowledge Is Forests' Need

(*Continued from Page 17*)

use of our forest resources, but from devastation, it becomes more and more urgent that some definite action be taken to stop the ruthless destruction before the price which we must pay in the form of greatly increased denuded area and attendant economic losses and all the other losses which go with the loss of our National Forests become a national catastrophe.

To meet this situation, it is vitally and urgently necessary to arouse public opinion, through public interest and public knowledge. At the present time forest fires are the greatest single destroyer of forests. In addition to adopting strenuous measures to prevent and cut down the number of forest fires and vast acreage which is burned over each year public sentiment should be moulded to encourage the replanting of vast areas of burnt over land. According to the U. S. Department of Agriculture, the National Forests contain several millions of acres of forest land so severely burned that it cannot be restocked without planting. To restore this land to timber production is an immediate federal responsibility. Tree planting is most urgent on denuded watersheds from which water is obtained for power, irrigation or municipal use. The work already done by the Forest Service has established method, cost and the limit to the successful reforestation by artificial methods. This project can therefore be undertaken upon an assured basis of cost and results.

At the same time there is a responsibility upon every one who senses the seriousness of the situation and the necessity for action to do everything within his power to advance an understanding of the country's reforestation needs, and to assist practically in meeting those needs through every means at his command.



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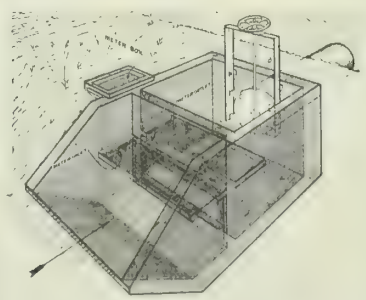

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MANAGEMENT

URGES "APPLICATION SYSTEM" FOR CITRUS USE

By W. M. MERTZ

THERE ARE at this time no subjects of such general interest to the California farmer as those pertaining to irrigation. Due to the three dry winters just past our sources of irrigation water in 1925 were shorter than ever before in the history of Southern California. True, we did not suffer as we did in 1899 and 1900, but our gravity sources were considerably less during the past summer than was the case either of those dry years. The drilling of innumerable wells all over the southern part of the state and the forming of several artificial lakes by means of canyon dams so augmented the diminishing gravity flows that an irrigated acreage many times larger than that in 1900 has suffered very little from the shortage of rains during the past three seasons.

However, the continued lowering of the water levels of our wells in all our irrigated districts could not have gone on much longer without being felt in a real water shortage. When water is being pumped out of our underground basins faster than rains and snows in our mountains are replenishing it, it is simply a matter of time when a share of the wells will give out entirely. In many cases these will undoubtedly be those on the upper levels, which may drain out first, and it is here that one often finds the most profitable citrus property. It thus becomes of vital importance to all agricultural interests to use water more efficiently than in the past and especially is this true of the citrus grower who in many cases is already feeling the shortage and who, at least on the acre basis, has the greatest investment at stake.

Water Use Not Uniform

Citrus properties over the state are using very different total quantities of irrigation water. In some districts growers are raising good crops with only 18 to 24 inches of irrigation water per season. In other districts it is not uncommon to find uses of over 40 acre inches where the climate is no hotter or drying in summer, and where the trees are no larger, and strange as it may seem, in very many cases the crops taken from the heavily irrigated groves do not indicate any superiority due to the larger use of water. During the past three years, when the natural rainfall has been very short, those districts where larger volumes of irrigation water have been customarily used show, as a rule, better crops than those where the minimum irrigation water had been available. In fact, many of the orchards on heavy soil are carrying better crops now following the dry years than were harvested during years of normal rainfall, indicating that many of these heavy soils had been receiving too much water. On those receiving a minimum of irrigation water it soon became apparent that scanty rainfall and small applications of irrigation water ultimately reduced the available water for the orchard to a point where maximum production of satisfactory sized fruit was impossible.

MR. MERTZ' article, which is an excerpt from a paper delivered before the recent Citrus Institute, at San Bernardino, California, discusses a practical problem of real interest to irrigators. While it is addressed primarily to the grower of citrus fruits, it contains suggestions of value to all orchardists who irrigate on a fixed schedule.

The second part of Mr. Mertz' paper was devoted to general methods of increased efficiency in the application of irrigation water to the grove. It, too, is large with helpful suggestions for all irrigators using the furrow system of application. It will be presented in an early issue as a continuation of the accompanying aricle.

Allow me, first of all, to emphasize the need of all growers to curtail the use of water to the point of actual necessity in order that our underground basins may not become so depleted that the upper districts be caused to suffer heavy economic losses. By a study of your local moisture conditions throughout the season, many growers in the damper coastal districts as well as most growers on heavy soils, should find it possible to use less water and find in so doing that the great majority of their properties would actually improve from this reduction in water applied. This reduction in water will of necessity entail some additional study and labor, for when just enough water is applied great care must be exercised so to distribute it that portions of the orchard do not suffer for water.

The greater crops of better sized fruit which will ultimately result from more uniform water distribution should much more than offset the somewhat greater expenditure of labor in so distributing the water. In fact, the present crisis which is facing us is not an unmixed evil, for out of it already is growing a better understanding of the actual water needs of a citrus tree and bringing in improved systems for the distribution of water both as relates to main lines and in the orchard itself. In addition, public sentiment is being crystalized in favor of greater conservation of our water sources and will ultimately make Southern California more safe from a serious water shortage than she has ever been in the past.

Now I wish to go more in detail as to means of increasing the efficiency of irrigation water as it applies to our individual groves.

Favors "Application" Scheme

In the first place, I wish to emphasize the advantages that accrue from obtaining irrigation water "by application" as it is called in distinction from the still all too common "fixed schedule." By "application," I mean the system of obtaining your irrigation water by applying for it at such times as you actually need the water, while the "fixed schedule" system gives the grower no option in this matter and he is compelled to take his irrigation water on a certain date or—passing this date—he must wait until the period comes around, a matter of from three to five weeks.

A great amount of water can be saved by the application system during periods of cool weather or after late spring rains as well as from the fact that water users on heavy soils would not desire their water as frequently as the schedule

usually calls for and would go two or three weeks longer between runs if it were possible but would not dare to entirely skip a run and thereby double the intervals. This later saving during the hot summer months is often not a net saving in the water since under application the man on sandy open soils would be inclined to order water more frequently than the schedule would call for but in the long run it is a saving for both sets of growers since those on heavy soil save expense on water they did not use and which if used would have actually harmed their property, while those on sandy soil through the more frequent applications of water are enabled to bring their groves up in production to very much more than offset the some what greater cost of water applied.

Change in System Benefits

Since the Santa Ana Valley Irrigation Co. went over from schedule to the application system, the groves on heavy soil have notably improved both as to appearance and production for an immediate reduction in water used was apparent on these heavier soils. Although many of the sandier soils under service from this same water company used more frequent irrigations than in the past, this company has been able to supply water to its members on reasonable notice even these last two years when water has been shorter than in the early days of the schedule system.

At times of heavy use a limit is placed on the amount of water which can be used per acre per run, but as soon as this is completed the user can make arrangements to re-order should he feel the soaking insufficient to hold the soil moist for as long an interval as usual. This limit has never been lower than two acre inches which is as much as some companies give regularly on a fixed 30-day schedule. Now this mutual company furnishes water to some 17,000 acres and depends to quite an extent on pumps for its water during the fall months. No reservoirs are used in this system, so there appears to be no real reason why this application system of distributing irrigation water should work more easily with this company than with scores of other mutual companies in the citrus belt of California.

In fact, I cannot see why more mutual companies have not changed their methods of distributing water to their members long ago, for the growers who sit on directorates of all such companies have known for years that different soils require different amounts of water and at different time intervals if maximum results in the way of crops were to result. After all the evils which have been pointed out recently as starting in the use of too much water, I believe no large

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water company need fear that the change from schedule to application would immediately result in an increased use of water. Experience of those companies already having tested it shows the opposite to be true.

If the growers bunch their orders too much, start the pumps and during the rush double the cost of the water if necessary to cover expenses. A lesson or two is all that is necessary and they will string out in fairly good shape, although during excessive heat waves or dry winds it may be necessary to tax the entire system to the utmost, but who of us would not be more than willing to pay double if only water could be gotten when we badly need it?

My experience certainly causes me highly to indorse the application system both as it relates to the saving of water on lands which do not need it, and also from the fact that it puts in the hands of the grower himself the decision when he should irrigate his orchard and in most cases also allows him to gauge the amount he should apply without wasting it in runoff or too deep penetration at the upper end of his furrows.

Many of us, however, must be satisfied with the schedule system at least for the time being. Fortunately much of the land on certain of these systems is of rather uniform soil and although the schedule is a bit too long for the grower on very sandy soil as a whole it is doubtful if the interval could be changed to suit all growers any better as long as it remained a fixed schedule.

Is Cultivation a Fallacy?

(*Continued from Page 20*)

to be equally good growth in all of the tanks and no differences could be distinguished between the growth made by the plants in the tanks which had been cultivated and those which had not been disturbed.

Several tanks containing clay loam soil were irrigated on May 13, 1922, and the surface of the soil was undisturbed until October 26, 1922, during which time 32 pounds of water were lost through evaporation. The soil to a depth of 12 inches was removed and placed on canvas, thoroughly mixed and then replaced in the tanks. Vetch plants which had been grown in flats were planted in the tank. No water was applied to the soil and the tanks were protected from rains. The vetch plants matured, making a growth comparable to that of similar plants in the orchard. The crop was raised by means of water applied 167 days before planting.

The clay loam in these tanks had a relatively high moisture holding capacity

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and the plants were grown for the greater part of the time when the transpiration losses were low. Of course, it is obvious that such an experiment could not be carried on with soil of low moisture capacity or during a time when the atmospheric evaporating power is high. However, this does show clearly that there was a relatively large quantity of water left in the soil after long exposure to evaporation and that there were no differences in available moisture in the soils which had been cultivated and those which had not been cultivated.

Transpiration Major Factor

These experiments also show that the amount of water taken from the soil by plant transpiration is tremendously greater than that evaporated directly from the surface of the soil. Records obtained from tanks in which trees were growing and which were covered so that the losses of moisture were confined almost entirely to transpiration losses afforded an opportunity to compare further transpiration with evaporation.

In 1921, a three-year-old prune tree in a tank used 585 pounds of water between May 21 and Nov. 21, a period of six months, while a similar tank containing the same kind of soil but uncropped and cultivated, lost only 28 pounds within the same time. This same tree, from March 1, 1922, to Nov. 4, 1922, used 1,250 pounds of water, while the uncropped tank, which was irrigated Feb. 11, with 23 pounds of water, again lost only 28 pounds between this date and Nov. 4. The bare, uncultivated tank just mentioned contained Yolo loam, which had been packed in the tank in 1912 and had not been disturbed since that time.

In view of the results obtained from these experiments, some of which have been presented here, the question "What becomes of irrigation water?" might be answered by saying that, under usual California orchard conditions, by far the greater portion of the total amount which is applied to the soil occupied by roots remains in the soil until it is taken out by plants.

Engineering Society Celebrates

The San Francisco Society of Engineers gathered in the assembly hall of Islames Temple, Oakland, Friday evening, April 16th, celebrating their annual smoker. Song, dance and musical entertainers enlivened the event with specialty features, after which the members shared in a dinner. Co-operating with its Oakland members, 300 members of the Society were present.

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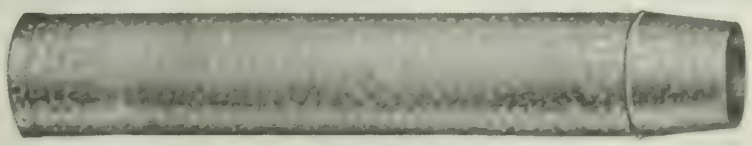

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WITH THE WATER COMPANIES

Of Interest Expressly to Water Works Engineers, Superintendents and General Managers

HOW THE LABORATORY PROTECTS THE WATER USER

By DR. CARL WILSON

Director, Biological Laboratory, Los Angeles Bureau of Water Works and Supply

MODERN water works engineers have found that the laboratory is an important adjunct to their equipment; and, furthermore, that its usefulness is in large degree proportionate to the complexity of the system.

Los Angeles has a remarkable water supply—perhaps it would be correct to say that it is unique—in the wide range of biological conditions which are to be found over its catchment and impounding areas. The water-shed tributary to the Owens River aqueduct covers a region of more than 100 miles from north to south, and embraces the highest portion of the Sierra Nevada mountains as well as broad valleys, and even encroaches upon the edge of the desert. Tributary to the supply are more than 40 glacial lakes lying at elevations of from 8,000 to 11,500 feet above sea level, part of them snow-bound throughout the year.

The impounding system within a radius of 50 miles of Los Angeles has a number of large lakes under semi-tropical conditions, while between these two extremes can be found practically every intermediate type of environment. Since surface waters are profoundly influenced by their surroundings it is not surprising that Los Angeles has found itself face to face with numberless problems regarding control of growths which would affect the quality of its water supply.

Twelve years ago William Mulholland, Chief Engineer of the Los Angeles Bureau of Water Works and Supply, recognized the fact that comprehensive and long continued studies of the lakes and streams would be necessary in order to exercise the desired degree of control of such growths, and he accordingly inaugurated a laboratory division which was housed at Water Department headquarters where the engineering staff could keep in close touch with the work.

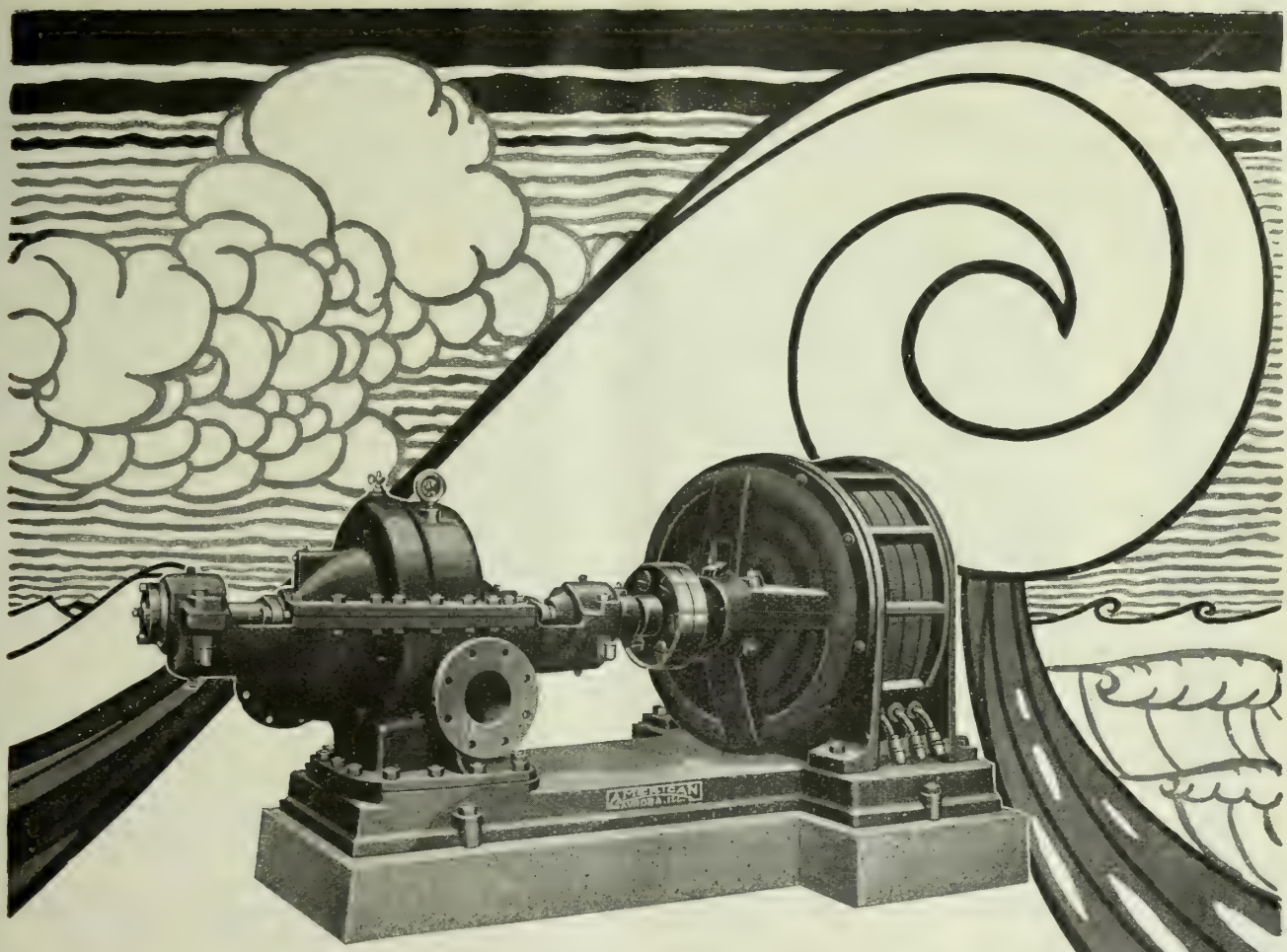
The first laboratory consisted of one small room in an out-of-the-way corner, but the equipment which was purchased at that time was carefully selected with the thought always in mind that it would form the nucleus of the complete laboratory which, it was expected, would be developed later. The laboratory outgrew its quarters twice, and has recently been installed in the new Water and Power building at 207 South Broadway. Here separate rooms are provided for the bacteriological work and for the chemical laboratory, while another room is used as an office and library.

In these completely equipped rooms a force of six workers, trained in the chemistry, bacteriology, and biology of domestic waters, are constantly at work on the diverse and interesting problems which beset the way of an engineer who attempts to furnish 165 million gallons of water per day to a great city.

The safety of a water supply is, of course, its paramount requirement, and consequently knowledge of the sanitary quality of the water as it goes to the consumer is the first concern of the laboratory. Wherever surface waters are used there is always the possibility which, however remote it may be, must be considered, that the water may be polluted at the last moment by a typhoid carrier, and to guard against this the latest practice is to sterilize such waters as they enter the distribution mains.

Miss Dorothy Brink, one of Dr. Wilson's assistants, peers through her microscope in a corner of the most completely equipped waterwork laboratory in the entire west. The laboratory is maintained in a scrupulously clean and sterile condition, as is suggested by the hospital-like appearance suggested in the photograph.

The Los Angeles system is so complex in its structure that six separate sterilization plants are needed in order to treat all the water. This means that a number of samples must be taken every day to be certain these plants are functioning properly, and that the water as it enters service is safe. The director of the laboratory has been made responsible for these plants, as well as



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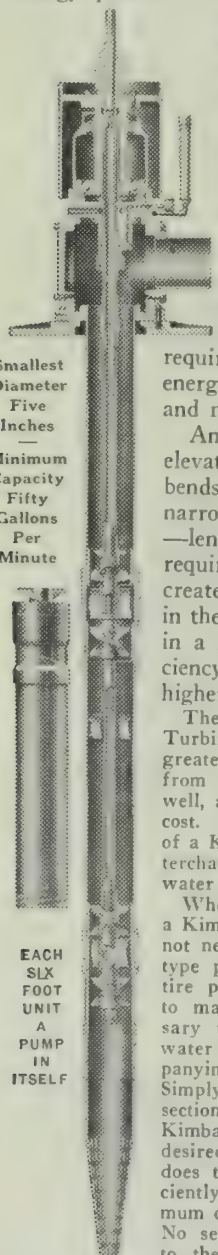

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for any other chemical treatments which may be required at any point on the system.

It is interesting to note in passing that chlorine requirements at different points on the system, and at different times of the year, vary from one and a half pounds per million gallons to as high as five pounds per million gallons. The higher dosage is employed to destroy objectionable taste which is at times imparted to the water by growths of algae.

The Laboratory Routine

An average day's work in the bacteriological laboratory involves the examination of from 30 to 60 samples, taken from key stations so distributed over the system that perfect control of the water may be obtained. The City Health Department, under Dr. George Parrish, takes other samples regularly to check the work of the Water Department, and the State Board of Health, under R. F. Goudey, its sanitary engineer, takes other samples at frequent intervals. Thus the water consumer in Los Angeles has a triple assurance that the tap water is safe to drink at all times.

The bacteriological work on any water system is practically a routine matter, and of particular interest only to bacteriologists, so no further comment upon that branch will be made here, other than to state that the technique followed is that prescribed by the American Public Health Association.

Combatting Algae Growth

Growths of organisms other than bacteria, most of them microscopic in size, afford by far the most interesting problems which come to the laboratory and some of them have been solved by new and novel methods.

There are more than sixty varieties of plankton algae which are found in our waters during all or part of the year, and which occur in sufficient numbers to be of economic importance. With over thirty reservoirs, large and small, the labor of collecting plankton samples and actually counting the numbers of each type of organism present involves an immense amount of detail work, for such samples have to be taken twice a week at least.

Every water works operator knows how quickly such growths can develop and here in Southern California where the sun shines nearly every day in the year and water temperatures remain high for months at a time, it is no wonder that growths of algae are frequent and abundant.

Before control work was undertaken, mixed growths of Anabena, Aphanizomenon and Clathrocystis developed in Haiwee reservoir, an artificial lake 7½ miles long located in the desert, 200 miles north of Los Angeles, so abundantly that in the coves and bays windblown accumulations formed masses three inches in thickness, and it was possible to pick up solid blocks of this material just as one might pick up broken fragments of ice. No water works superintendent needs to be told what such a growth of algae can do to water.

Fortunately Haiwee reservoir is the first of a chain of lakes through all of which water has to pass before it reaches the consumer, and limited control measures in Haiwee, Fairmont and Dry Canyon reservoirs have been found sufficient to keep the water in acceptable condition, provided complete control is exercised in the remaining reservoirs nearer the city. Copper sulphate treatments are relied upon for the destruction of growths but the dosage used on the Los Angeles lakes is rather lighter than is generally recommended. As little as one part in ten millions is often used, while one part in three millions is about as high a dose as has been applied for general treatments. In conduits where it has been necessary to destroy an attached growth, doses of twenty parts per million have been used, but of course this was only possible where the treated waters could be wasted and the conduit subsequently flushed to waste before being restored to service.

Among the most interesting organisms which have caused trouble on the system are Beggiatoa, Crenothrix, and Plumatella. These have been conquered, but it is always possible, due to the physical character of the system, for Plumatella to appear again, and this organism is the one which is potentially the most objectionable because of the mechanical troubles it causes in the distribution system. Crenothrix flourishes only in iron-bearing water, and Beggiatoa only where sulphur is available. Both iron and hydrogen sulphide are absent from practically all of the Los Angeles supply, being found only in small quantities of water pumped from certain well groups, so neither of these organisms has given long continued trouble, but they are always unwelcome visitors.

Mineral Analyses Frequent

A great many complete mineral analyses of waters from all parts of the system are analyzed every year, and partial analyses covering a few constituents are made in great numbers. The chemical laboratory is also called upon, from time to time, to examine materials used in dam construction, as well as to investigate the origin of seepage waters. During the coming summer a new line of investigation is planned to determine whether algae may be controlled by ar-

tificial adjustments of hydrogen ion concentration in the reservoirs. Research work along other lines is contemplated, but in the past limited room and personnel made such studies impossible.

In conclusion it may be said that the laboratory sometimes solves problems which otherwise are very stubborn. Several years ago stickleback appeared in immense numbers in one of the terminal reservoirs, and these fish, when less than half an inch in length, went through the screens and to the consumer's tap. Naturally complaints were numerous and vociferous and something had to be done, but what? Screens were ineffective and all other measures which were tried proved useless. The laboratory discovered that stickleback in a mountain stream fifty miles away were dying from a flatworm parasite which was known to affect only five species of fish, and to be unable to live in the body of a warm blooded animal. This parasite was promptly grafted upon the stickleback in the reservoir, and a few weeks later all the annoysome fish had been killed. They have never reappeared and probably will not, as they are known to be absent from the waters feeding this chain of lakes.

Sugar Cane Irrigation Shown Profitable

Continuation of the co-operative investigations of the irrigation of sugar cane by the Department of Agriculture in 1925 confirms the conclusion based on the work of previous years that such irrigation is profitable.

The experiments are conducted by the Division of Agricultural Engineering of the Bureau of Public Roads in cooperation with the Columbia Sugar Co., near Franklin, La. Comparing irrigated with unirrigated sugar cane, an average increase in yield of 3 tons per acre and an estimated increase of 480 pounds of sugar recovered per acre are the results obtained in 1925. The season began with a severe drought and ended with a very wet fall. The 1924 season was an unusually dry one and an increased yield of 5.6 tons per acre was obtained. The two preceding seasons were so wet that no irrigation was necessary.

It is believed that the profits due to irrigation in dry years will more than offset the cost of maintaining irrigation facilities in wet years when no irrigation is necessary.

The same pumping plant was used to irrigate both cane and rice. The economy of this system is apparent where rice may profitably be raised on the same plantation as sugar cane. The amount of water that was needed was diverted from the rice ditch and forced to the high point of the cane field and allowed to run down the furrows and across each succeeding headland.

View of a section of a 60-mile pipe line of Oklahoma Natural Gas Company. Coated with Biturine Enamel under Contract by Hill, Hubbell & Company. We undertake complete contracts, or furnish a competent foreman, or supply the material with complete directions.

The A. B. C. of Corrosion Prevention

Q: What causes corrosion? A: Directly or indirectly the contact with metal of moisture, acids and alkalies such as commonly found in the air or the soil. All authorities agree on that.

Q: What prevents it most effectively? A: A Coating of metal surfaces that permanently inhibits such contact.

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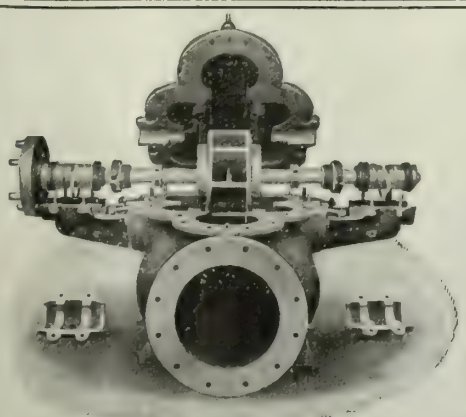

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RECLAMATION

DR. WORK PRESCRIBES H_2O FOR SOUTHWEST'S ILLS

APPEARING on April 26 before an audience that filled Los Angeles' largest dining hall to overflowing, Hubert Work, Secretary of the Interior, gave the Colorado River Boulder Dam project the most outspoken endorsement that it has ever received from an administration leader. Secretary Work and Elwood Mead, Commissioner of Reclamation, were present as the guests of the Los Angeles City Club and Chamber of Commerce, but the audience that heard the Secretary's remarks was broadly representative of official, business and agricultural leadership throughout Southern California.

Arthur Bent, himself an outstanding figure in hydraulic development, called the meeting to order as president of the Los Angeles commercial body, and introduced George Dunlop, president of the City Club, as presiding officer. In commenting on the purpose of the meeting, Mr. Bent complimented the leaders of the Interior Department for their efforts to free the Colorado River from political considerations, and to study it as a purely engineering and economic problem.

Dr. Work's Specific

Mr. Dunlop presented Dr. Work, expressing the hope that he was about to write the largest and wettest prescription of his many years of medical practice, and the Secretary fulfilled expectations. His remarks were delivered under the handicap of sickness, but were nevertheless eagerly listened to, and were big with meaning for his attentive audience.

In part, Secretary Work's remarks were as follows:

"This tremendous engineering task (the proposed developments of the lower Colorado River) if carried out, will rescue from menace the homes of 60,000 people, and farms valued at more than $60,000,000. It should, when completed, more than double the reclaimed area in a section of the country where climate contributes the greatest value to irrigated crops. This agricultural development will be supplemented by an industrial development only second in importance, due to the creation of a great volume of cheap power. It offers certainty and security of an increased water supply to two great cities of the arid region, Denver, east of the Rockies, and Los Angeles, west of the Coast Range, both outside the watershed of this river and both dependent on it for their future growth.

"The pending Colorado River compact should make possible a just division of the river waters between the upper and lower States, and bring to an end a threatened and costly interstate rivalry. The proposed compact opens the way, too, for the settlement of an international problem, along lines which will safeguard the use of this stream for our own people and work no injustice to our Mexican neighbors.

World's Greatest Project

"These potential benefits are enough to make this a development of great national interest and importance. But, also, there are still other unique and significant features which are epochal and far-reaching. In its engineering phases, the proposed project will be the greatest work of its kind in the world, the highest dam, the costliest canal and one of the largest developments of hydroelectric power,—all intended to contribute to human welfare and the creation of new wealth throughout the Colorado basin and tributary country.

"The necessity for an early settlement of the respective rights of the different States and two nations in this river, and in the carrying out of the proposed development on the lower portion of the stream, is vital. We have come West to see the location where the principal works are to be built, and meet the people primarily interested, whose future progress is so largely dependent on this development.

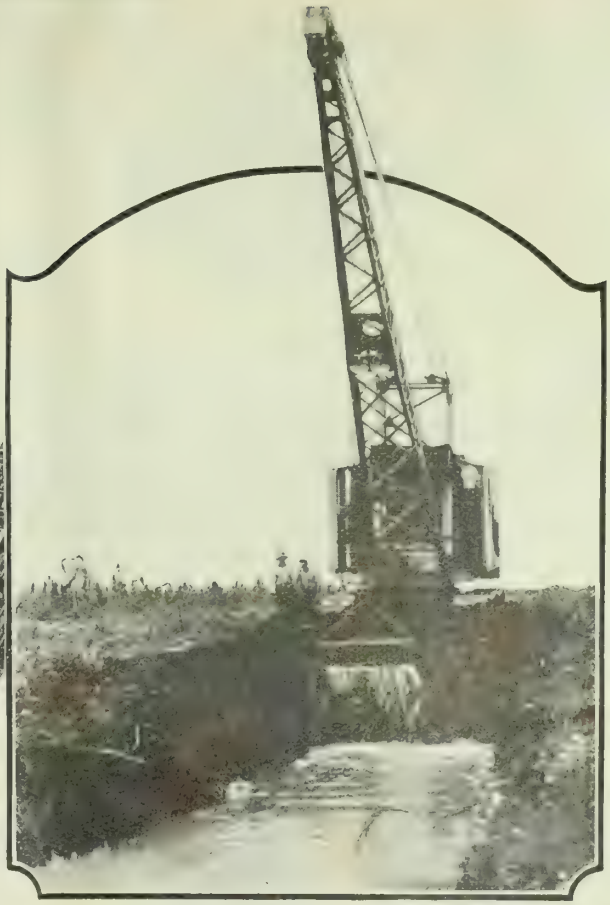
"Prominently before the Congress now is the matter of the development of the Colorado River in its entirety. Fortunately, Northern and Southern California have agreed to further the dam project, which is of first importance to you. All of the basin States, with one exception, are in accord. The Administration agrees with these States as to the importance of developing this potential national asset, and is hopeful that permanent and satisfactory adjustments for river use between the several States and our Mexican neighbors can be established for all time.

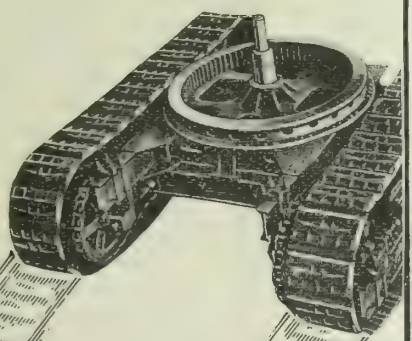
Too Big for Private Hands

"I am opposed to government ownership or operation of any public activity that is within the compass of private citizens. For five years I have been directing government services under a mandate to 'centralize authority and decentralize responsibility.' But conflicting, diversified and far-flung interests are involved in the Colorado River development, that compel a closely knit organization to correlate them.

"No individual or corporate entity licensed for totally different and diversified purposes, could be found to guard one interest and equally protect the rights of others.

"The citizens' right of appeal is their due against unfair advantage by monopolistic utilities, but no local authority can compel services from a company not included in their charter or for which they are not paid to perform. States' rights for civil protection and local industrial development is fundamentally sound in theory and an essential to a proper functioning of the Federal Government. Yet, changing conditions have waged an economic, social, industrial and governmental revolution in this country in the past ten years. The World War broke down precedents and practices and, because of our readjustments, we would now seem to appear as a new nation. Larger corporations and mergers are a necessity because of these changed conditions and men's views, too, must change to meet them. But corporations are not geared to operate unrelated businesses or to bring about interstate and international comity, and mergers have been compelled which contemplate consolidations of related business to cheapen their service. Many, perhaps, are not pleased with the change,





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but it is here, and a new epoch in the nation's history is being written. . . . .

INERTIA CAUSES DELAY

"Though the Lower Colorado River development has been under consideration by Congress for two generations, nothing tangible, constructive, or lasting has ever been accomplished. Through legislative procedure the bill came to the Department of the Interior for comment relating to possible policy and suggestions for administration.

"For the first time, concrete, specific recommendations, comprehending the diversified and coordinated use of the river, were made to Congress by the present administration of the Interior Department, which reported frankly, carefully and sympathetically, on this bill. Proposals by the Department for certain changes in the bill were immediately approved by its authors and today, as you know, the measure is awaiting definite action by Congress. The Interior Department is openly supporting the general principles of the bill, but delay in the enactment of this measure is being caused by the inertia which all great undertakings encounter, and the necessity for adjusting rival and conflicting views.

"Some progress has been made in negotiations with Mexico, looking to the safeguarding of the river rights of that country in relation to our own, but no authority to obligate this Government in any co-operative manner can, of course, be exercised without action by Congress, and Congress is to adjourn very shortly, possibly without action on this Boulder Dam project.

"My proposal, that the funds needed for this entire development be obtained from the sale of Government bonds, was made because it is believed that enough revenue can be obtained from the sale of water for irrigation and domestic use, and the sale of power, to make this a solvent undertaking, paying interest on all the money expended and returning the principal within a reasonable time. To finance the enterprise in this way would remove a serious objection from taxpayers in other parts of the country, who can see little reason for advancing funds out of the national Treasury as a temporary expedient, to be replaced by them in the form of taxes, when it may be possible to make the project a self-sustaining one without disturbance in the fiscal operations of the Government. . . . .

WEST MUST REMOVE DOUBTS

"Early action should be directed to removing the misgivings of doubters as to your necessity for more water for irrigation and domestic uses, and it should be shown that there is a sufficient

demand from industries for the power that can be generated.

"Should Congress fail to instruct the Secretary of the Interior to secure contracts for the sale of power and water from the Colorado River, to potential consumers, he proposes to initiate such procedure himself and, if possible, have formulated something tangible to present to Congress when it meets next winter. These proposals will have to be of a general character, because work of this magnitude will require from five to ten years to complete, and the proposals will have to be for a service which does not begin now but at least five years in the future. This fact, however, is not an argument for delay. On the contrary, it is the most potent argument for early authorization to construct. . . . .

"The dam, regarded solely for manufacturing, and sale of power alone, would be a departure from established Government policy, without justification in precedent. Protection against floods, adjudication of rights to the use of waters in international streams, protection of watersheds and navigable streams, are recognized functions of the Government. Reclaiming land by irrigation for agriculture, anticipating annually recurring drouth peculiar to arid regions, has been accepted as Government practice. All of these will be touched or determined by the construction of the proposed Boulder dam, which, in itself, however, is of less moment than the ratification of a satisfactory river compact between States, the United States, and Mexico.

"Destruction from floods and probable drouth are local problems. Production of power for light and manufacture are constructive suggestions. Compacts to regulate use of water have to do with comity between neighbors having separate rights to a common opportunity provided by nature and are largely moral in their relations, but none the less compelling in their claims for consideration.

"No structures heretofore built for any of the purposes indicated promised a cash return, except reclamation. The proposed Boulder Dam bill promises to utilize the water it will store, to amortize its costs, and even now some 25 applications from private parties are pending for permits to build power plants on the higher reaches of the Colorado River.

Private Developments Encouraged

"It is my belief that as soon as the Boulder Dam legislation has been approved by Congress, the applications for private power developments should have immediate consideration. There does not seem to be any danger that the pow-

(*Continued on Page 43*)

For Cleanout -- Maintenance -- New Ditches

There's a Bay City for Every Job

BAY CITY Land Dredges span the ditch, can dig any desired slope, and dump waste on both banks. BAY CITIES leave clean, wide berms, and can work up or down streams. One trip over the ditch is enough. The Shovel Type Dipper handles hard material in which other types of buckets cannot make a good showing.

At left—One yard BAY CITY Dredge digging and cleaning ditches in Florida Citrus Groves.

BAY CITY Land Dipper Dredges are built to fit the job. Walking, Crawler, Track or Floating mounting. Easily dismantled, transported and assembled. Capacities ½ to 1½ cubic yards. Oil engine or electric operation.

FOR SMALLER DITCHES — OR PIPE LINE TRENCHES

The BAY CITY 16-B convertible Excavator will handle a wide range of work. Operates Dragline, Trench Shovel, Clamshell or Skimmer. All steel. Shipped assembled. Digs any width or depth up to 20 feet.

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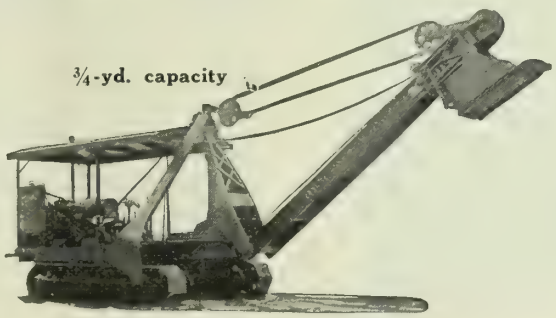

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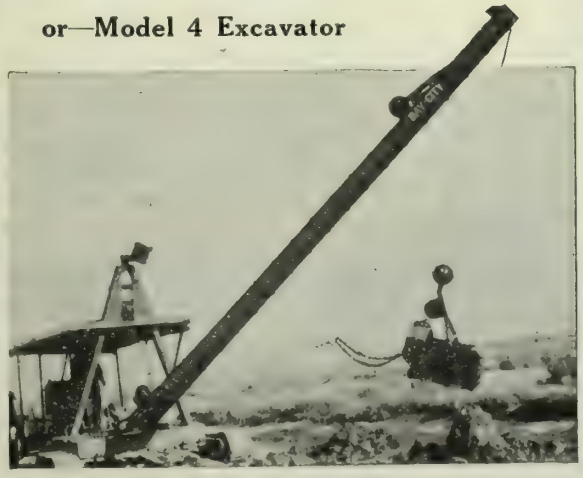

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WHO'S *WHO* AND WHO'S *WHERE*

IN THE WORLD OF HYDRAULICS

Personal Notes and Impersonal Observations About Men You Know

George W. P. Hunt, now serving his fifth term as Governor of Arizona, has announced that he will be a candidate for re-election. Governor Hunt has been prominent in his activities relating to the development of the Colorado River, and is counted one of the most powerful opponents of the ratification of the interstate compact.

General Lansing H. Beach, former chief of engineers of the U. S. Army, General W. H. Langfitt, former chief of engineers in France, and A. J. Wylie, of Boise, Idaho, former reclamation service engineer, have been appointed as a board of consulting engineers to pass upon the plans and specifications for the Coolidge Dam at San Carlos, Arizona.

C. T. Pease, formerly of the U. S. Reclamation Service and regarded as one of the foremost engineers in government service, died recently at his home in Denver, Colorado. For some time he was project manager of the Uncompahgre Project in Colorado, and was a member of the advisory board appointed to report on the Columbia Basin project.

A. M. Van Norman, assistant to William Mulholland, chief engineer for the Los Angeles Bureau of Water Works and Supply, late in April made an inspection tour of the work being done by the city on its Colorado River aqueduct and the filtration canal work going on near Blythe, California. The city is installing pumps here to test the flow of water through the gravel and determine the possibilities of getting clear water from this source.

Officials of Bellingham, Washington, including Mayor John A. Kellogg, City Engineer J. C. Hills and City Water Superintendent J. B. McMillan, visited several large cities of the northwest in April in conference with consulting engineers on water problems of their municipality. The city is seeking a suitable engineer to be retained by the water department to survey and draw plans for an enlarged and improved system to care for the potential demands of a population of 200,000.

Well known irrigation men of Washington were in conference with officers of the Walla Walla Irrigation Company in April on its hearings before the state department of hydraulics, involving its rights to water from the Walla Walla River and tributaries. Charles J. Bartholet is the referee in the proceedings; Fred J. Cunningham of Spokane represented the claims of the company, and Marvin Chase, former superintendent of hydraulics and L. O. Jaynes, land expert, from Olympia, were interested.

Representatives of the Yakima, Kittitas, Kennewick and Yakima-Benton (Washington) irrigation districts are to unite in a league for the promotion of their common interests, and the formulation of a development policy upon which all can agree, if plans laid in April come to fruition. The four districts were represented in a meeting at Yakima April 17 when it was decided that one man from each of the districts will be appointed to serve with O. C. Soots, representing the Yakima Chamber of Commerce, as a fifth member.

F. A. Reid, president of the Salt River Valley (Ariz.) Water Users Association, was returned to that office for a term of two years in an election in April, when the shareholders of the association gave him a majority of approximately two to one over his opponent, Thomas Maddock. C. S. Stewart was re-elected without opposition as vice-president of the association. Andreas Jepson, member of the board of governors, was defeated for re-election by John Dobson. George Day was elected to the council in place of L. E. Graham. The council and board of governors are solidly in support of the administration policies of President Reid as the result of the election.

The city and county of San Francisco and the cities of the San Francisco peninsula are negotiating for a basis of cooperation which will mutually assist in the solution of their water problems. A committee representative of both interests has been appointed under the auspices of the League of California Municipalities to study the water situation and to suggest a form of organization and plan of action which would make it possible to meet the needs of the whole peninsula in one project. Supervisors Warren Shannon and M. F. Kent and City Attorney J. J. O'Toole of San Francisco, Professor C. D. Marx, of Palo Alto, and O. F. Weissergerber of San Mateo, comprise the committee.

Dr. George P. Clements, director of the agricultural department of the Los Angeles Chamber of Commerce, was host at the University Club, Los Angeles, on May 3, to a group of representative conservation and forestry men of the southwest, who gathered to honor Stuart B. Show, recently appointed California District Forester, U. S. Forest Service, and to discuss with men of the forest service some of the urgent conservation problems facing California. Mr. Show has recently succeeded Paul G. Redington as District Forester, and the occasion was his first official visit to the southern part of the state since his advent to that office. Among those who met at the invitation of Dr. Clements were: Judge Harold Curzon, forest enthusiast and conservation "evangelist;" George H. Cecil, supervisor of the Angeles National Forest; S. B. Morris, superintendent of the Pasadena City Water Department; Burlingame Johnson, chairman of the conservation committee of the California State Senate; C. E. Jordan, district forest inspector, San Francisco; J. E. Elliott, supervisor of the Cleveland National Forest; Everett Stanford, deputy county forester of Los Angeles County; Robert Deering, assistant district forester, San Francisco; Samuel Borden, supervisor of the San Bernardino national forest; William Mendenhall, supervisor of the Santa Barbara national forest; E. I. Kotok, inspector of California forests, San Francisco; J. M. Paige, secretary, Pomona Chamber of Commerce; L. S. Gilman, President, Angeles Forest Protective Association; Douglas G. McPhee, Editor of MODERN IRRIGATION, and the guest of honor, Stuart B. Show.

Dr. Work Prescribes for Southwest

(*Continued from Page 41*)

er market will be oversupplied. On the contrary, cheap power will help to open up new mines, promote the building of new railroads, and multiply industries. Your State laws would be ample protection to producing companies and their patrons alike, but it is not clear that licensees could be compelled by law or regulation to guard an international agreement for water storage, stream equation or division, give equal consideration to the dominant uses of agriculture, domestic water and flood control —in short, of this natural asset,—when the ever-present necessity for financial returns on investments would press.

"I must view this vital matter, in the Department of the Interior, from the standpoint of a public servant. The tenets of this measure can not be written to suit every one interested. The Colorado River compact is being resisted by a State that could profit by this comprehensive development. Maneuvering for individual or corporate advantage is being resorted to by those speculating in hopes, but it is confusing the main issue. If there are among you individuals who for personal, partisan or political advantage are embarrassing this project, they should be excluded from your councils.

"I have submitted proposals to Congress, intended to show how this development may be effected by the government on commercial lines, the revenue to repay the costs with interest, in a reasonable time.

"If an organized corporation, competent and willing to develop this project in its several ramifications, will come forward and submit a contract to build these structures and place their operation under such control of the government as will protect the many and diversified interests involved, the Secretary of the Interior will recommend to Congress that such proposition be sympathetically entertained."

Dam Named for Senator Gibson

A tribute to the memory of former Senator Paris Gibson of Montana will be paid to him by designating as "Gibson Dam" the proposed storage dam on the Sun River irrigation project in Montana. The tentative plans for the new dam, which will bear the Senator's name, call for a masonry structure more than 200 feet in height, with a crest length of 820 feet and a volume of 195,000 cubic yards. The area of the reservoir behind the dam will amount to 1,360 acres, with a capacity of 105,000 acre-feet.

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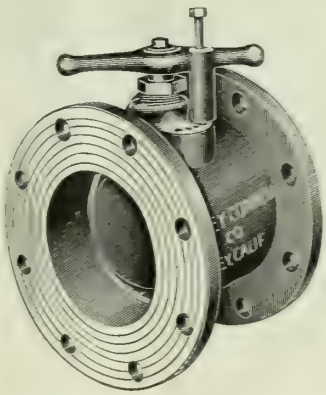
FLEXIBLE SHAFT COUPLINGS



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Bronze gates and moving parts.

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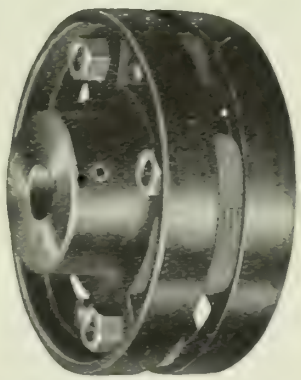

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LEGAL *and* JUDICIAL

A DEPARTMENT CONDUCTED BY HANKINS & HANKINS

Finality of Order of Board of Directors

An order of a board of directors of an irrigation district in excluding lands is held to have force of judgment.

The Supreme Court of Colorado, in the case of Yellow Jacket Irrigation District v. Pleasant Valley Ranch Co., 243 Pac. 635 (Jan. 18, 1926) held, on the question of the finality of an order of the Board of Directors excluding certain lands from the district, "That the Board of Directors was a tribunal whose decision has the force of a judgment." The Court cites in support of the statement the case of Wilder v. Irrigation District, 135 Pac. 461, where the tribunal under consideration was the board of County Commissioners, but where, it claimed, the analogy was complete.

What Constitutes Prescriptive Right?

To establish a prescriptive right to the use of a ditch something more than mere permissive use must be shown.

In the case of Abrams v. Colwell, 243 Pac. 615 (Colo. Feb. 1st, 1926,) the plaintiff brings a suit to quiet her title to an easement consisting of a right to conduct water across the lands of defendant through pipe line and canal, and introduces evidence of an executed parole license and a claim of right for more than 20 years. The defendant claimed that the use was permissive only and could be revoked at any time.

In supporting the judgment in favor of the plaintiff the court stated "It is true that, in order to establish a prescriptive right, something more than mere permissive use must be shown, but in the instant case much more than permissive use is shown, and the evidence relative to the prescriptive right, considered in connection with the evidence of an executed parole license is ample to sustain the findings and decree."

Rights-of-Way and Ways of Necessity

A right of way for a ditch to irrigate lands is not a "way of necessity".

In the action of Alcorn v. Reading, 243 Pac. Rep. 922, (Feb. 8th, 1926), the Supreme Court of Utah held that the common law rule as to a "way of necessity" arising where a man purchases land accessible only over the land of the vendor . . . he shall have a way of necessity over the land which gives access to his purchase, did not apply to the matter of an irrigation ditch.

In this case plaintiff was the owner of certain lots of land across which, at one time, had been constructed an irrigation ditch. Defendant had purchased certain other lots from the same grantor as plaintiff, and went upon the lands of plaintiff for the purpose of cleaning out and using this ditch. Neither the ditch nor the water rights were referred to in the deeds of plaintiff or defendant although the ditch was easily to be seen at the time that both plaintiff and defendant obtained their lands.

In denying the defendant any relief under the theory of "way of necessity" the court states:

"The common law doctrine relating to ways of necessity, undoubtedly was founded upon an absolute necessity of the case. Without such rule there was no means by which the right could be enforced against the consent of the owner. No right of condemnation was allowed if the right sought was for a private purpose. The same rule exists today in the jurisdiction in the case of ways of necessity, for ingress and egress across the lands of another. A different rule applies in this state in the case of canals and ditches and other means of conveying water for beneficial purposes. These are declared to be public uses by statutory provisions (Laws of Utah). The right of condemnation for such purposes is thereby allowed without regard to whether the right is sought by the public, or by a private individual. It follows, therefore, that in this jurisdiction where a right of way for an irrigation ditch can be obtained under the statute of eminent domain, the right cannot be obtained on the theory that it is a way of necessity enforceable under the rules of the common law . . ."

The court further says: "We base our decision, however, upon the proposition that an easement for an irrigation ditch upon the theory of an implied reservation does not exist in this state, however necessary the easement may be, for the reason that the statute of eminent domain provides a complete remedy by proceedings in condemnation."

Limitation of District Warrants

Irrigation district warrants out-law in four years.

A very interesting decision was rendered by the District Court of Appeal of California, Third District, in the case of People vs. Honey Lake Valley Irrigation District, et al., Vol. 59 Cal. App. Dec., page 830 (April 7th, 1926) wherein various points arising through the issuance of Irrigation District warrants under the California Irrigation District Act were passed upon.

The case arose on a petition for the dissolution of the irrigation district and the intervention of certain warrant holders asking for judgment against the district for the amount of their warrants. The District pleads the four-year statute of limitations. In its decision, holding the warrants and claims to be outlawed, the Appellate Court held:

(a) District warrants without a due date are payable on demand and the statute of limitations commences to run from the date of the warrant.

(b) District warrants are general obligations of the Irrigation District and the rule that the statute of limitations does not commence to run until funds are available where warrants are payable out of a specia fund, does not apply.

(c) The proper remedy of the warran holders was to bring a suit in mandamus either against the district, or if the distric could not function, then against the boar of supervisors, to compel the levy of a assessment to pay the warrants.

(d) The warrant holders could hav avoided the bar of the statute of limitation by converting their claims into judgments

What Is A Spring?

"Spring," as water source, defined b Supreme Court of California.

In the case of Harrison, et al. v Chaboya, et al. ———Cal. Dec.——— (April 22, 1926) the Supreme Cou of California defines the meaning of th word "Spring" as applied to a sourc of water supply.

The "Spring" consisted of a woode box sunk in a marshy place and radia ing troughs leading to this box. Lat a second box was sunk about forty fe away and the two boxes connected b a pipe line.

The controversy arose over the que tion of whether the deed in using th

words "all the water issuing from our spring . . . located on the west end of a certain tract of land" conveyed the right to the use of the water from the swampy area, or was limited to the water in the first box.

The Supreme Court stated: "We are of the opinion . . . that the term 'spring' in its common acceptation, at least in California, is a term which, in general usage, has been applied to damp, marshy or boggy area, usually of small but definite extent, wherein underground waters from a larger tract of land find their way to the surface thereof and make their presence known either by a definite outflow or by the surface presenting such a quantity thereof as will render practicable their assembling in such receptacles as those described in the record herein. . . .We incline to the opinion . . . the testimony . . . would constitute a sufficient basis for its (trial court) finding that the waters issuing from the earth at both of the indicated points were waters which had a single source, and hence were embraced within the terms of the original grant of the easement . . ."

Don't Forget Ground Water

(Continued from Page 16)

seems simple to put down a well, and sites for wells, in most instances, have been little guided by scientific study. In fact, in the majority of instances where advice has been solicited as to well location, sites were largely selected, until the past decade, by a process that had no relation to the natural sciences but rather the super-natural. This process is known as "water witching" and, even though the process has been thoroughly discredited, there are still many localities where the advice of a "diviner" is solicited.

It should be evident to all that the opinion of a geologist, in our present state of knowledge, should be more valuable than that of one who professes to have the gift of divination. Geologists, in selecting and recommending sites for development, are liable to miscalculation and failure if their broad training and experience has been deficient in the specific application of geologic processes and phenomena to the occurrence, distribution, and movement of ground-water. However, the greatest error the geologist falls into is that he overlooks the necessary hydraulic and hydrographic elements of this problem. His training is lacking along this line. His geologic conclusions as to the presence of an aquifer which has all the characteristics which would enable it to store and yield abundant water may be correct, but the development may be a failure because

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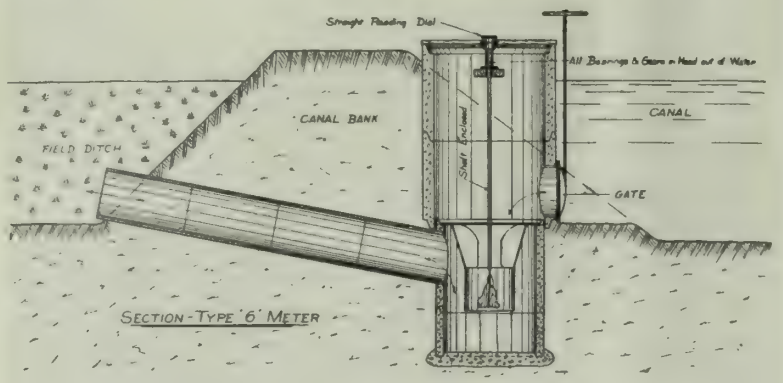
The RELIANCE METER



THE "Type 6" Reliance Irrigation Meter offers you standardized permanent construction at a very low first cost. Their sustained efficiency with a minimum of upkeep has been proven by 12 years usage. Cut shows installation of the 4 sec. ft. size in 24 and 30-inch concrete pipe. This is the standard type of setting adopted by many irrigation districts in Texas and elsewhere who are now equipping all their deliveries with this device. The "Type 6" meter is furnished in sizes ranging from ½ up to 16 sec. ft.

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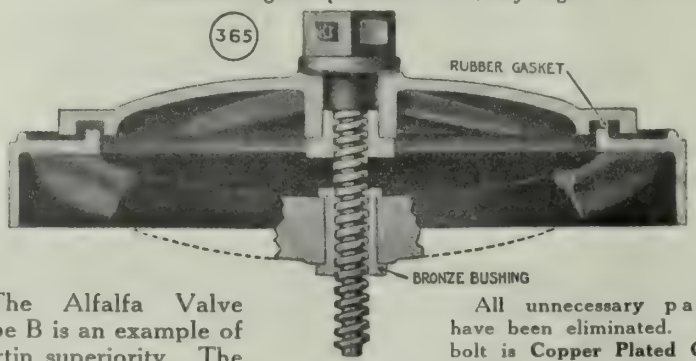

The Alfalfa Valve Type B is an example of Martin superiority. The solid flange encircling the concrete pipe protects the pipe from breakage and forms the best method of permanently cementing the valve to the pipe.

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of the lack of external water to supply and recharge the aquifer.

The engineer is at a great disadvantage unless he has sufficient geologic training to be able to ascertain the origin and history of rock formations, to interpret geologic structure, and understand the modifying effect they have upon the hydraulic elements of his problem. Therefore we believe the function of "divining" should rightfully and most successfully be limited to the ground-water hydrologist.

This brings us to the question of what knowledge one must possess in order to qualify in ground-water hydrology. The experience of the writer, together with professional contacts with engineers and geologists engaged upon like problems, have shown him that the broad fundamental training of either alone is inadequate to an understanding of the principles involved in the science of ground-water hydrology.

The science of geology contributes a knowledge of the geologic processes through which rock formations (and included in this term are the accumulations of unconsolidated alluvial, aeolian, glacial, and residual rock materials) originate to become water containers and by which the occurrence of ground-water in them is controlled. Geologic structure is also largely controlling in the occumulation and circulation of ground-water within rock formations. The science of hydrology contributes the all-important knowledge of the origin and source of ground-water and related hydrography; hydraulics contributes the principles of ground-water movement under certain conditions, and the discharge and yield of water from underground sources. From the science of hydrostatics are obtained the principles which are largely controlling in the broader movements and circulation of the ground-water body. Many other phases of ground-water hydrology are based upon principles set forth in soil mechanics, irrigation, drainage, sewage filtration, and other special branches of engineering and geological endeavor.

Such knowledge appears to be widely scattered and impossible to obtain without extensive study of many publications. This is true, as at present there is no comprehensive text published covering the field, but study can be guided so as to direct the student of engineering or geology, who plans to practice in the West, in his search for such knowledge, if the subject be deemed of sufficient importance to justify the time spent in covering it. Some of the considerations involved in this phase of the question will be reserved for discussion in a second installment of this article.

For Detailed Listings, Branch Offices, Etc., See the Buyers' Guide to Leading Supply Sources—Pages 55-56

READER INTEREST

—How Can the Publisher *Guarantee it?* —and How May the *Advertiser* Know that he is *Getting it?*

SPACE buyers may not agree upon all of the accepted standards by which advertising mediums are selected. They may, for example, hold radically opposite views as to the value of "mass coverage" versus the concentrated appeal.

But on one cardinal point the opinion of the whole advertising fraternity is unanimous. The publication must have strong reader interest. Without *reader interest* a publication is worthless as an advertising medium. Conversely, the greater the reader interest the greater the value of the medium to its advertisers.

Business men nowadays have time to read but few publications. The magazine that claims their undivided attention must dominate in reader interest. And how may it so dominate? By *concentrated appeal.* By class interest. By editorial value to ONE GROUP ONLY and by serving *that* group well.

The strength of MODERN IRRIGATION as an advertising medium lies in the fact that it affords advertisers a "rifle shot" straight to a selected group of buyers—the tremendous buying power of the irrigation and hydraulic industry. It is not for the advertiser who prefers the blunderbuss type of medium—patronized so often by concerns selling to several industries, which imagine that by using the medium of diversified appeal they may kill several birds with but a single stone. Good argument, here, for the advertiser—but how about him who counts the most, the man who reads it? Does he feel that it applies directly to *his* industry and will help him solve the daily problems of *his* particular business?

For every industry has its own highly specialized problems. *Only to a publication devoted to hydraulics exclusively* may the irrigation executive and engineer, the land owner, the contractor and the waterworks man, turn for complete, up-to-the-moment, authoritative information. Only upon the medium of concentrated, group appeal can they depend, month after month, for the current news developments of their industry, as well as for invaluable technical material.

For such mediums as this there can be no adequate substitute. They are the publisher's very best guarantee of reader interest—the highest reader interest it is possible for a publication to have. And they are the advertiser's safest assurance of a profitable return upon his advertising investment.

MODERN Irrigation

For Detailed Listings, Branch Offices, Etc., See the Buyers' Guide to Leading Supply Sources—Pages 55-56

IRRIGATION FINANCE

IRRIGATION NEEDS CAPITAL -- CAPITAL NEEDS IRRIGATION

By JOHN DWIGHT NEALE

Delivered before the Irrigation Districts Association of California

MODERN RECLAMATION is no longer an individual or partnership undertaking. Large capital expenditures are involved which necessitate the issuing of bonds to be sold to private and corporate investors.

Thus the interests of a large number of people are involved in an irrigation enterprise:—The landowners and farmers; the contractor and engineers; the lawyer and the investment banker and the investor.

The silver cord of life to all communities of the arid West is the irrigation canal.

I recently visited a section of Arizona, on the lower Gila River, where no present-day signs indicate any former habitation or development, except some long unused ditches.

In 1878, irrigation of that section began, and soon families and homes and productive farms were found in the valley, and instead of the desert, fruitful harvests abounded.

This happy condition obtained for 13 years until 1891, when a great flood on the Gila washed out the temporary, farmer-built dam, changed the course of the River so that the main stream could no longer be easily dammed and diverted by the farmers and their crude tools and dirt-moving machinery, and when the silver cord was broken, it was not long until the desert crept back and instead of happy homes, fruitful farms and many indications of a settled community which obtained there 45 years ago, we now find thorns, centipedes and horned toads.

Three Lessons from Arizona

This example of an irrigation system which functioned for a time—and then ceased—demonstrates clearly at least three facts, pertinent to Western America, viz:—

Construction and maintanance of irrigation systems are no longer individual or partnership undertakings, but rather are of a type involving the public and large capital expenditure; without irrigation, much of the West is largely a desert; county, city and school district bonds, issued by western communities, can be considered no more reliable or permanent than the irrigation systems which serve the populations of those political subdivisions.

It might be an interesting and very worth-while topic for discussion by the Irrigation Districts Association of California, to seek some of the underlying causes of a condition which directly affects every western interest and community.

An Anomalous Price Situation

When City of Merced Bonds are being retailed on a 4.40 per cent basis, and Merced Irrigation District Bonds are obtainable in the same market at prices to yield nearly 6 per cent, something must be out of joint in capital's attitude, as the Merced Irrigation District includes the City of Merced and in addition thereto an area of about 180,000 acres of irrigable land, over half of which is under a high state of development.

Both City of Merced and Merced Irrigation District Bonds are payable from unlimited ad valorem taxes, and in each instance, failure to pay property taxes forfeits ownership and possession.

If unfavorable comment and publicity has led the investing public to believe that City Bonds are a safe investment, while Irrigation District Bonds are speculative, it seems high time that this Association and all thinking Californians should take such definite steps as will remove public prejudice against the securities of the West's basic industry.

Those making these comments may only be echoing reports they receive from what they deem official sources.

It should be the business of this Association to publish facts covering actual achievements of irrigated agriculture in the West and if, as has been reported, the U. S. Bureau of Reclamation does not give out the statements which are representative of actual achievements, it is certainly in order that this Association go on record here and now, by proper resolution, calling the attention of the Secretary of the Interior and the Commissioner of Reclamation to the tremendous importance of giving the newspapers, which mould public opinion so largely, representative accounts of advancement and achievement of the Reclamation Bureau, rather than statements which may tend to destroy public confidence—not only in the work of the U. S. Reclamation Service, but in the securities issued by western irrigation districts, without which no large development of a western agriculture or other western natural resource, is probable or practicable.

If the West continues to grow and achieve, irrigation must be given the earnest attention, warm sympathy and loyal support of every western business and enterprise.

Growth Depends on Irrigation

A section of our country which cannot keep even its lawns green in the summertime, without irrigation, cannot long afford to ignore a situation where credit is not encouraged to enter wholeheartedly into the development of those very things which perpetuate the growth, happiness and existence of its population.

We originally stated in this address that irrigation development is no longer an individual or partnership undertaking in which, by the contribution of a few days of work by each farmer affected, an irrigation system can be built.

We have reached the time in California when irrigation systems require large capital expenditures to build and the public is now being called upon to buy irrigation securities.

Credit follows public confidence. Let all Californians make sure that real confidence exists and endures.

Manufacturers' and Dealers' Place In Pump Sales Discussed by W. I. E. A.

HOW THE USER of irrigation equipment may be best served, for his own ultimate good and the success of the manufacturer and dealer as well, was the question that received the greatest share of attention from the members of the Western Irrigation Equipment Association, in session at Fresno, California, on April 16.

In the general discussion that featured the business meeting, the prevailing opinion was that the local dealer should carry on the sale of pumping plants and similar equipment, because of his ability to render instant and understanding service to the user.

Several manufacturers expressed a cordial and hearty agreement with this policy in the abstract, but objected that its defect was in a lack of dealers who appreciated their responsibility and opportunity. "There are not enough of the right sort of dealers to go 'round," was the manufacturers' complaint.

Discussion on this problem, which is a real one involving the interests of maker, dealer and user equally, brought out the dealers' position that they must be given the chance to sell and service the equipment if they are to maintain their position in the business, while the manufacturers respond that if the dealers assume this responsibility they must live up to it in efficient and reliable service. The good offices of the Western Irrigation Equipment Association, as the organization uniting both interests, and serving for the presentation and discussion of their mutual problems, were commended as the best solvent for their troubles.

Business and Fun

The Fresno meeting, as usual, was a lively one in both business and banquet sessions. Business transacted included:

The adoption of a constitutional amendment providing that the president of the association may not succeed himself, and an amendment of the by-laws providing for the appointment of a nominating committee in advance of the election of officers.

The submission of six additional sheets for the association's data book by C. F. Zimansky, president, and the appointment of a committee comprised by E. M. Breed, C. F. Zimansky, E. K. Barnum and H. W. Brown to examine and pass upon the accuracy of all material submitted for inclusion in this hand-book.

A report on the activities of the publicity committee, by C. B. Noyes, chairman, who submitted several designs for an official association medallion and predicted that the right kind of publicity would help to iron out the difficulties between the buyer and seller of equipment.

Ben D. Moses, representing the California Committee on the Relations of Electricity to Agriculture, reported progress, but not completion, on the standard form of contract which is being worked out by the Association to cover the terms and guarantee of pump sales by its members. He also reported that the Pacific Hydraulic Engineering Association is lending effective cooperation to this effort.

A greeting and proffer of close cooperation was tendered on behalf of the Hydraulic organization by E. M. Breed, its vice-president.

Next Meeting July 30

C. B. Noyes, paying tribute to the interest and activity of well-drillers in the irrigation industry, advocated that the problems of this element of the association's membership should be given more emphasis, and it was decided that the next meeting of the organization, which will be held at Stockton, July 30, will be largely devoted to well-drillers' concerns. J. E. Lundy, General Manager of the Sterling Pump Works, Inc., will be general chairman of the arrangements committee for the July 30 meeting at Stockton.

A. K. Flynn, well driller of Orange Cove, was accepted as a member, cordially pledging his best efforts to advance the association's interests.

Seventy-five were present at the evening banquet at the Hotel Fresno, with A. M. (Jack) Frost in the spot-light as toastmaster. W. I. E. A. talent provided the music, and the volunteer actors, vocalists and yodelers discovered among its membership stood all over the floor and the piano while they made the welkin ring.

Two interesting talks were presented, both of which had direct application to irrigation problems. H. N. Carroll, of the San Joaquin Light and Power Corporation, Fresno, brought out some interesting information when he discussed "Cotton in the San Joaquin Valley."

Seventy thousand acres in the San Joaquin Valley are under pump irrigation, and the average head for cotton is 77 feet. More than $400,000, it is estimated, has been spent for irrigation equipment for use in irrigating cotton in the valley during the past two years.

Max W. Enderlein, Fresno consulting engineer, spoke on "Underground Water Supply of the San Joaquin Valley," urging the necessity of conserving irrigation water by preventing seepage and evaporation. Mr. Enderlein stressed the importance of using underground pipe wherever possible.

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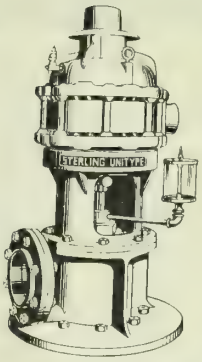

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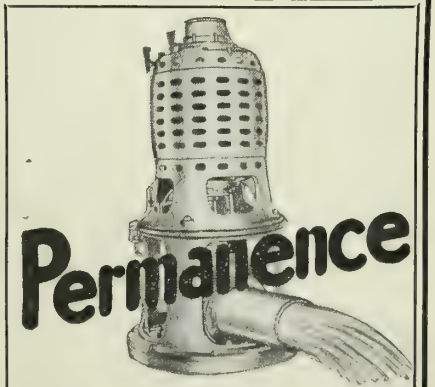
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SURVEY *of* HYDRAULIC DEVELOPMENT

As Shown by Official Records of the Month -- Local, State, and Governmental

Permits Issued

Among the more important permits to appropriate water issued by the Department of Public Works, Division of Water Rights of California, during the month of April, 1926, were the following:

Permit No. 2452, Application No. 3544 (Siskiyou County). Issued to Montague Irrigation District of Montague, California, April 3, 1926, for 55,000 acre feet per annum from Shasta River in Sec. 25, T 43 N. R 5 W. for use for irrigation of 19,500 acres in the Montague Irrigation District. Estimated cost $1,200,000.

Permit No. 2453, Application No. 3555 (Siskiyou County). Issued to Montague Irrigation District of Montague, California, April 3, 1926, for 15,000 acre feet per annum from Parks Creek in Sec. 29, T 42 N, R 5 W. for use for irrigation of 19,500 acres within the Montague Irrigation District.

Permit No. 2454, Application No. 4482, (San Mateo County). Issued to Pigeon Point Lumber Co. of Pescadero, California, April 9, 1926, for 10 cubic feet per second from Gazos Creek in Sec. 33, T 8 S, R 4 W. for use for power purposes in Sec. 33, 68 T. H. P. to be developed. Estimated cost $4,000.

Permit No. 2455, Application No. 4057 (Eldorado County). Issued to Eldorado Power Co. of San Francisco, California, April 12, 1926, for 250 cubic feet per second and 7500 acre feet per annum from Silver Park in Sec. 35, T 11 N. R 15 E. for use for power purposes in Sec. 28, 24858 T. H. P. to be developed. Estimated cost $3,659,000.

Permit No. 2456, Application No. 4687 (Eldorado County). Issued to Eldorado Power Co. of San Francisco, California, April 12, 1926, for 7500 acre feet per annum from Silver Fork in Sec. 35 T 11 N, R 15 E. for use for power purposes in Sec. 15, T 11 N. R 12 E. 122,564 T. H. P. to be developed.

Permit No. 2457, Application No. 4686 (Eldorado County). Issued to Western States Gas & Electric Co. of Stockton, California, April 12, 1926, for 7500 acre feet per annum from Silver Fork in Sec. 35, T 11 N, R 15 E. for use for power purposes in Sec. 20, T 11 N, R 11 E. 27982 T. H. P. to be developed.

Permit No. 2458, Application No. 4868 (Eldorado County). Issued to Henry Bacchi of Lotus, California, April 13, 1926, for 0.05 cubic feet per second from Indian Creek in Sec. 6, T 11 N, R 10 E. for domestic use, stock watering and irrigation of 4 acres in Sec. 12, T 11 N. R 9 E. Estimated cost $15,00.

Permit No. 2459, Application No. 4228 (Amador & Calaveras Counties). Issued to East Bay Municipal Utility District of Oakland, California, April 17, 1926, for 310 cubic feet per second and 217,000 acre feet per annum from Mokelumne River in Sec. 26, T 5 N, R 10 E. for use for municipal Utility District. Estimated cost $80,000.

Permit No. 2460, Application No. 4796 (San Bernardino County). Issued to Claude W. Chapman of Venice, California, April 26, 1926, for 0.001 cubic foot per second from an unnamed spring, in Sec. 22, T 2 N. R 1 W. for use for domestic purposes in Sec. 22. Estimated cost $225.00.

Permit No. 2461, Application No. 4624 (Siskiyou County). Issued to G. C. Williams of Happy Camp, California, April 26, 1926, for 20 cubic feet per second from Oak Flat Creek, in Sec. 19, T 16 N, R 7 E. for use for placer mining near point of diversion. Estimated cost $8,000.

Permit No. 2462, Application No. 4564 (Eldorado County). Issued to Mrs. W. W. Price & E. G. Galt of Fallen Leaf and Tallac, California, April 27, 1926, for 1 cubic foot per second and 464 acre feet per annum from Grass, Gilmore, Susie, Halfmoon & Heather Lakes in Secs. 7, 8, 14, 17, 19, 21, T 12 N. R 17 E. for use for power purposes in Sec. 14, 119 T. H. P. to be developed.

Permit No. 2463, Application No. 4806 (Monterey County). Issued to Alfhild Borgstrom of San Francisco, California, April 27, 1926, for 0.05 cubic foot per second from The Sunshine Springs in Sec. 20, T 20 S. R 3 E. for use for irrigation of 2½ acres near point of diversion. Estimated cost $1250.00.

Permit No. 2464, Application No. 4822 (Butte County). Issued to P. N. Ashley of Biggs, California, April 28, 1926, for 7 cubic feet per second from Lateral A of Reclamation District 833, in Sec. 3, T 18 N. R 2 E. for use for irrigation of 305 acres near point of diversion. Estimated cost $1400.

Permit No. 2465, Application No. 4859 (Butte County). Issued to Bill Gianella of Marysville, California, April 28, 1926, for 3 cubic feet per second from North Honcut Creek in Sec. 2, T 18 N. R 4 E. for use for irrigation of 265 acres near point of diversion. Estimated cost $1500.

Permit No. 2466, Application No. 4873 (Los Angeles County). Issued to Frank P. Sentous of Newhall, California, April 29, 1926, for 0.18 cubic foot per second from German Canyon in Sec. 2 T 3 N. R 15 W. for use for domestic and irrigation of 15 acres in Sec. 2. Estimated cost $100.

Permit No. 2467, Application No. 4915 (Eldorado County). Issued to James Keane et al. of Sacramento, California, April 29, 1926, for 0.62 cubic foot per second and 20 acre feet per annum from Hubbard & Indian Creeks in Sec. 7, T 11 N, R 10 E. for use for domestic and irrigation of 50 acres in Sec. 7. Estimated cost $500.

Grants Public Utility Certificate

The California Railroad Commission has granted a certificate to W. F. Kime to operate a public utility water system in Tract No. 5775, Los Angeles county and has fixed a schedule of rates therefor.

Applications Filed

Among the applications for permit to appropriate water filed with the State Department of Public Works, Division of Water Rights, (California) during the month of April were the following:

Application No. 4985 (Ventura County). Gregory M. Creutz, 601 Pershing Square Bldg., Los Angeles, California, for 3 cubic feet per second and 200 acre feet per annum from Little Sycamore Canyon, tributory to Pacific Ocean. To be diverted in Sec. 22, T 1 S, R 20 W. S. B. M. for irrigation and domestic purposes on 320 acres.

Application No. 4986 (Ventura County). Guy T. Stetson and Henry S. Nixon, Trustees for the proposed Ojai Irrigation Dist. Care J. B. Lippincott, 543 Petroleum Securities Bldg., Los Angeles, California, for 100 cubic feet per second from N. Fork Matilija Creek, tributary to Ventura River. To be diverted in Sec. 20, T 5 N. R 23 W. S. B. M. for irrigation and domestic purposes on 1500 acres. Estimated cost $30,000.

Application No. 4987 (Ventura County). Gregory M. Creutz, 601 Pershing Square Bldg., Los Angeles, California, for 3 cubic feet per second and 200 acre feet per annum from Little Sycamore Canyon, tributary to Pacific Ocean. To be diverted in Sec. 22, T 1 S, R 20 W. S. B. M. for irrigation and domestic purposes on 480 acres.

Application No. 4988 (Ventura County). Gregory M. Creutz, 601 Pershing Square Bldg., Los Angeles, California, for 2½ cubic feet per second and 200 acre feet per annum from branch, Little Sycamore Canyon, tributary to Pacific Ocean. To be diverted in Sec. 14, T 1 S. R 20 W. S. B. M. for irrigation and domestic purposes on 640 acres.

Application No. 4989 (Butte County). Margaret A. Straughan, care Jerome D. Peters, Bank of Italy Bldg., Chico, California, for 2.8 cubic feet per second from West Branch Butte Creek, tributary to Sacramento River, to be diverted in Sec. 15, T 24 N. R 3 E. M. D. M. for power purposes in Sec. 22, T 24 N. R 3 E. M. D. M.

Application No. 4990 (Inyo County). William Hyder, 5671 Lemon Grove Ave., Los Angeles, California, for 0.25 cubic foot per second from Arrasta Spring tributary to Panamint Valley. To be diverted in Sec. 16, T 22 S. R 46 E. M. D. M. for mining and domestic purposes.

Application No. 4991 (San Joaquin County). Pescardero Recl. Dist. No. 2058, care Amos Jones, Box L-1, Trady, California, for 100 cubic feet per second from Tom Paine Slough and Paradise Cut, tributary to Lower San Joaquin River. To be diverted in Sec. 4, T 2 S. R 5 E. M. D. M. and 8 other points on Paine Slough and Paradise Cut, for irrigation purposes on 8,350 acres.

Application No. 4992 (Butte County).

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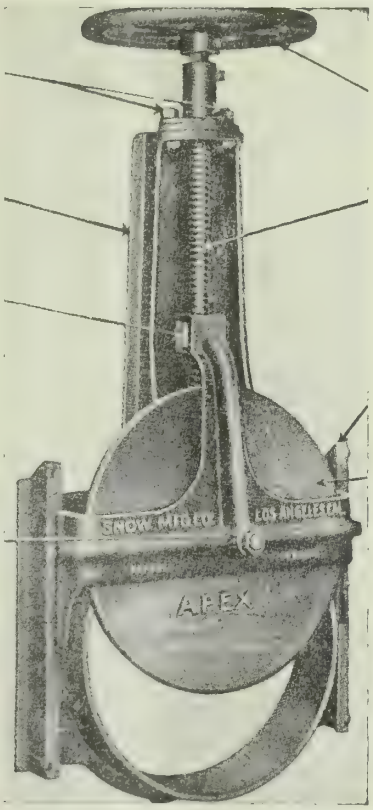

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Edith ad Victor Hoag, Gridley, California, for 1.85 cubic feet per second from Lateral E—1 A Recl. Dist. 833 tributary to Sacramento River. To be diverted in Sec. 3, T 17 N. R 2 E. M. D. M. for irrigation purposes on 74 acres of rice. Estimated cost $500.

Application No. 4993 (Butte County). G. R. Estes and Victor Hoag, care Grover R. Estes, Gridley, California, for 2.5 cubic feet per second from Main Canal—Recl. Dist. 833, tributary to Sacramento River via Butte Creek. To be diverted in Sec. 28, T 18 N. R 2 E. M. D. M. for irrigation purposes on 100 acres of rice in Sec. 28, T 18 N. R 2 E. M. D. M. Estimated cost $1,000.

Application No. 4994 (Ventura County). Gregory M. Creutz, 601 Pershing Square Bldg., Los Angeles, California, for 2 cubic feet per second and 200 acre feet per annum from Little Sycamore Canyon, tributary to Pacific Ocean. To be diverted in Secs. 3 and 10, T 1 S, R 20 W. S. B. M. for irrigation and domestic purposes on 160 acres in Sec. 10, T 1S. R 20 W. S. B. M.

Application No. 4995 (Ventura County). James Erwin, care Navy Oil Co., Box L, Taft, California, for 0.1 cubic foot per second, from unnamed stream tributary to Hopper Creek and Santa Clara River. To be diverted in Sec. 10, T 4 N. R 10 W. S. B. M. for domestic and irrigation purposes on 6 acres in Sec. 10, T 4 N. R 19 W. S. B. M.

Application No. 4996 (Humboldt County). A. W. Way, care Wynn Meredith, Box 527, Eureka, California, for 0.25 cubic foot per second from unnamed stream tributary to Mattole River. To be diverted in Sec. 30, T 2 S. R 1 W. H. M. for irrigation and domestic purposes on 30 acres in Sec. 30, T 2 S. R 1 W. H. M. Estimated cost $300.

Application No. 4997 ((1) Riverside (2) Imperial County). City of San Diego, office of City Attorney, City Hall, San Diego, California. To be diverted for 135 cubic feet per second from Colorado River tributary to Gulf of California. To be diverted in (1) Sec. 14, T 3 S. R 23 E. S. B. M. (2) Sec. 25, T 15 S. R 23 E. S. B. M. for municipal purposes in City of San Diego.

Application No. 4998 (Santa Barbara County). U. S. Dept. of Agriculture, Forest Service, Santa Barbara National Forest, Federal Bldg., Santa Barbara, California, for .025 cubic foot per second, from Paradise Creek, tributary to Santa Ynez River. To be diverted in Sec. 4, T 5 N. R 28 W. S. B. M. for domestic purposes in Sec. 4, T 5 N. R 28 W. S. B. M. Estimated cost $300.

Application No. 4999 (Tuolumne County). Sierra and San Francisco Power Co., 625 Market Street, San Francisco, California, for 9,000 acre feet per annum from Herring Creek, tributary to South Fork Stanislaus River. To be diverted in NE¼ Sec. 15, T 4 N. R 18 E. M. D. M. and SW¼ Sec. 15, T 4 N. R 18 E. M. D. M. for power purposes in Spring Gap, Stanislaus and Melones Power Houses. Estimated cost $100,000.

Application No. 5000 (Nevada County). Jonas Hirsch, Overland Hotel, Reno, Nevada, for 1 cubic foot per second from Juniper Creek tributary to Truckee River. To be diverted in Sec. 34, T 18 N. R 17 E. M. D. M. for power purposes in Sec. 34, T 18 N. R 17 E. M. D. M. 25 T. H. P.

Application No. 5001 (Alameda County). County of Alameda, office of Dist. Attorney, of Alameda County, Oakland, California, for 0.37 cubic foot per second and 60 acre feet per annum from Arroyo Del Valle, tributary to Alameda Creek. To be diverted in Sec. 4, T 4 S. R 2 E. M. D. M. for irrigation and domestic purposes on 30 acres. Estimated cost $30,000.

Application No. 5002 (Amador & Calaveras Counties). East Bay Municipal Utility Dist., 1924 Broadway, Oakland, California, for 750 cubic feet per second and 25,000 acre feet per annum from Mokelumne River, tributary to San Joaquin River. To be diverted in Sec. 16, T 5 N. R 11 E. M. D. M. for power purposes in Sec. 16, T 5 N. R 11 E. M. D. M. Estimated cost $800,000.

Application No. 5003 (Siskiyou County). Morgan A. Gunst, 601 3rd Street, San Francisco, California, for .0012 cubic foot per second from unnamed spring tributary to Klamath River. To be diverted in Sec. 24, T 47 N. R 6 W. M. D. M. for domestic and irrigation purposes on 10 acres in Sec. 25, T 47 N. R 6 W. M. D. M. Estimated cost $1,000.

Application No. 5004 (Yuba County). Pacific Gas & Electric Co., 245 Market Street, San Francisco, California, for 15,000 acre feet per annum from North Fork of Yuba River, tributary to Feather River. To be diverted in Sec. 24, T 18 N. R 7 E. M. D. M. Re-diversion in Sec. 25, T 18 N. R 7 E. M. D. M. for power purposes in Sec. 16.

Will Issue Securities

The Roseville Water Company has been authorized by the California Railroad Commission to issue on or before December 15, 1926, $61,000 of six and one-half per cent bonds, for the purpose of refunding its outstanding six per cent bonds, or sell on or before December 15, 1926, said $61,000 of six and one-half per cent bonds, at not less than 91 per cent of face value, plus accrued interest, and to use the proceeds, other than accrued interest, to redeem said $61,000 of six per cent bonds. The Commission also authorized the same company to issue and sell on or before December 15, 1926, $119,000 of six and one-half per cent bonds, and to use the proceeds thereof to pay outstanding indebtedness and to finance additions, betterments and improvements.

Bond Issue Authorized

The Hermosa-Redondo (California) Water Company has been authorized by the State Railroad Commission to issue and sell on or before December 1, 1926, $50,000 of its Series "A" mortgage, six and one-half per cent bonds, due December 1, 1953, at not less than 95 per cent of face value, plus accrued interest, $37,000 of its preferred stock at not less than 91 per cent of par value, and $26,500 of common stock at not less than 85 per cent of par value, and to use the proceeds to reimburse its treasury for capital expenditures and for additions and betterments.

To Qualify Directors

Ocean Park Heights Water Company has applied to the California Railroad Commission for authority to issue five shares of common stock to its officers and directors, for the purpose of qualifying such officers. The Gardena Valley Water Company has applied for permission to issue five shares of stock for the same purpose.

Would Revise Rates

Moor Park Farmers Water Company, furnishing water for irrigation and domestic purposes in Moor Park District, has applied to the California Railroad Commission for permission to revise its rates, rules and regulations for delivery of irrigation water.

OREGON

Among the more important applications for permit to appropriate water filed in the office of Rhea Luper, state engineer of Oregon, during April were the following:

W. G. Allen of Salem, covering the appropriation of water from Jones and Finney Lakes and Stream for irrigation of 240 acres in Marion County.

August Mooreman of Shaw, covering the appropriation of water from an unnamed stream for irrigation of 30 acres in Marion County.

J. O. Jones of Hood River, covering the appropriation of water from an unnamed stream for irrigation of 15 acres and development of 8 theoretical horsepower in Hood River County.

J. B. Stobie of Camas Valley, covering the appropriation of water from unnamed creeks for irrigation of 295 acres in Douglas County at a cost of $1500.

M. W. Mahoney of Portland, covering the appropriation of water from Mission Creek for irrigation of 103.25 acres in Marion County.

Harry V. Gates of Terrebonne, covering the appropriation of water from Crooked River for operating pumps and for the irrigation of 200 acres in Jefferson County.

J. R. Hills of Dexter, covering the appropriation of water from Hills Creek for fluming lumber and for irrigation of 600 acres in Lane County.

Joe Mash of Huntington, covering the appropriation of water from Becker Creek for irrigation of 25 acres in Malheur County.

Robert Meyer of Grants Pass, covering the appropriation of water from Onion Creek for supplemental irrigation of 18 acres in Josephine County.

Harry A. Johnson of Dufur, covering the appropriation of water from Eight Mile Creek and Tamarack Creek for irrigation of 20 acres in Wasco County.

Oswald West of Portland, covering the appropriation of 50 second feet of water from an unnamed stream leaving the Deschutes River on its East Bank approximately 1600 feet south of Lava Island in Section 27, Tp. 18 S., R 11 E., W. M., for irrigation of 2,000 acres of land in Deschutes County.

Mr. Grant Winters of Camas Valley, Oregon, covering the appropriation of water from an unnamed creek, tributary of Coquille River, for irrigation of 8 acres, in Douglas County, at a cost of $400.

Mr. F. C. Vaughn of Baker, Oregon, covering the appropriation of water from overflow of reservoir, City of Baker water supply, for irrigation of 95 acres in Baker County.

The Portland Electric Power Company of Portland, Oregon, covering the appropriation of water from Clackamas River, tributary of Willamette River, for generation of hydroelectric power in Clackamas County at a cost of $1,560,000.

Mr. Walt Smiley of Wilsonville, Oregon, covering the appropriation of water from an unnamed creek tributary of Willamette River for irrigation and power purposes in Clackamas County.

Gustav E. Stein of Sherwood, Oregon, covering the appropriation of water from Stein Creek, tributary of Willamette River, for irrigation of 40 acres and power purposes in Clackamas County, at a cost of $1,000.

Mr. J. B. Stobie of Camas Valley, Oregon, for the construction of Stobie Reservoirs for the storage of 100 acre feet from unnamed streams, tributaries of Coquille River. The stored water is to be used for irrigation.

Public Utility or Mutual Company?

Miller & Lux, Inc., has filed a petition for a rehearing of the California Railroad Commission of the recent order of the Commission in which the water system maintained by that corporation in the Miller and Lux Colony in the vicinity of Firebaugh and Mendota, Fresno County, was held by the Commission to be a public utility, and the owners thereof directed to refund to consumers moneys collected through the increasing of rates without authority of the Railroad Commission. Petitioners allege that the Railroad Commission erred in finding the said water system to be a public utility, instead of a mutual water system, as contended by the owner.

L. A. Company Would Expand

The Los Angeles Water Service Company has applied to the California Railroad Commission for permission to acquire and operate the properties of Consolidated Water and Development Company, South Park Water Company, Lawndale Land and Water Company, Melvin Place Water Company, and The Calhoun Plant, and also for permission to issue and sell 4,000 shares of common capital stock in part consideration of the transfer of said properties, and also to issue and sell $385,000 of bonds, bearing interest at rates of seven per cent per annum, for the purpose of financing extensions and improvements.

Water Held Not Harmful

Liberty Acres Water Company, operating near the town of Hawthorne, has been authorized by the California Railroad Commission to place in effect a new schedule of rates, including both flat rates and meter rates, and has been directed to take proper steps to assure a pure clean and unoffensive supply of water. The Commission found that the present complaint against the supply is due to sulphur contents and insufficient flushing of the mains but that the water is potable and not unhealthful.

To Issue $700,000 Bonds

The Monterey County, (California) Water Works has been authorized by the State Railroad Commission to issue $700,000 of first mortgage six per cent 30-year bonds for the purpose of financing acquirement of the water properties from Del Monte Properties Company and to finance additions and betterments, and to reimburse applicant's treasury for surplus earnings expended for additions and betterments.

Asks Higher Rates or Quit

The Stockton and Mokelumne Canal Company has applied to the California Railroad Commission for permission to discontinue service, or for an increase of rates, alleging that it cannot operate successfully under the present rates. Petitioner asks that if increased rates are granted they be fixed on a basis of returning eight per cent per annum on a valuation of $209,115.18.

Limoneira System Taken Over

The California Railroad Commission has granted a certificate to Farmers Irrigation Company, a corporation, to operate the water system in the territory formerly served by Limoneira Company near Santa Paula, and to charge the same rates now in effect on that system.

Out of Service

Laurel Canyon Land Company has applied to the California Railroad Commission for permission to discontinue service of water and to remove its equipment, its territory now being served by the Los Angeles City Water Works.

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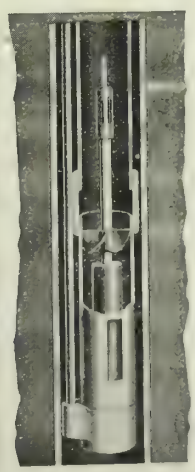

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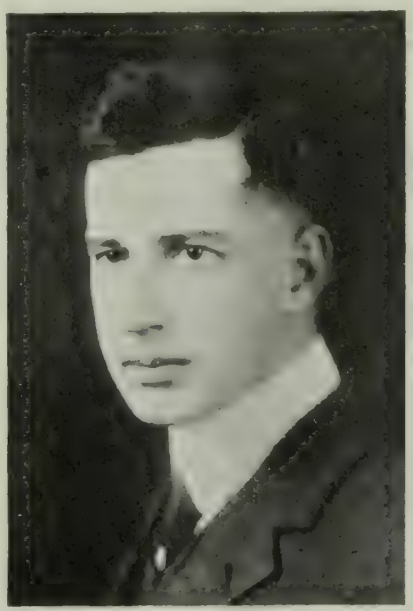
AMONG OUR CONTRIBUTORS

Editorial Jottings About Current and Forthcoming Feature Articles, Dealing With Practical Problems of Hydraulics, and the Men Who Have Written Them

COVERAGE of the diversified fields of irrigation and water development is the goal of MODERN IRRIGATION. In this issue, a suggestion of the wide scope of the magazine is indicated by the numerous departments touched, including management, engineering, cultivation, conservation, water works, law, finance, reclamation, etc. And of course these are not all. But the purpose of the magazine is to contact with every field which is directly allied to the hydraulic industries, and to make itself the publication of the water developers and water users of the entire west.

GEORGE L. SWENDSEN, who writes on "Fundamentals of District Management," is both an engineer and a manager, and in himself is an able illustration of the fact that these capacities may be successfully combined. He is a Harvard graduate who has spent twenty-five years in irrigation work in California, Idaho and Utah. From 1903 to 1906 he was district engineer in the U. S. Reclamation Service. From 1906 to 1917 he was connected with the construction and development of irrigation projects in Idaho, and in 1917 he came to California, where for three years he served in the direction of construction and operation of the deep-well pumping system of the Boston Land Company's project in the San Joaquin Valley. Since 1920 he has been in his present position as chief engineer and general manager of the Fresno Irrigation District, which includes 243,000 acres, with 10,200 water users. His article is prepared at the request of this magazine, based on a paper delivered to a recent meeting of the Irrigation Districts Association of California.

HYDE FORBES, who discusses the importance of ground-water studies to both student technologists and practicing engineers and geologists, is himself both an engineer and a geologist, and has specialized, in training and practice, in ground-water investigations and development for water supply and irrigation, and in the treatment of excess ground-water in drainage problems. His career, since his graduation from Stanford University in 1913, has included varied work of this sort for western irrigation organizations and municipalities. His present work is mainly of a consulting character, with offices in San Francisco. Studies of ground-water conditions under his direction have very thoroughly covered California from one end to the other. The latest task of the kind on which he has been engaged is a study of the effect of pumping ground water from the Owens Valley artesian areas by the city of Los Angeles.



PROF. F. J. VIEHMEYER

F. J. VIEHMEYER is a member of the faculty of the University of California, Department of Irrigation Investigations and Practice, who with his colleagues, is doing an invaluable work for irrigation by approaching its practices and doctrines in the spirit of scientific inquiry, and establishing by experimental evidence the foundations upon which the science of irrigation rests.

MALCOLM MUIR is vice-president of the McGraw-Hill Publishing Company, New York City, well known technical publishers. His interest in that fundamental problem of irrigation, reforestation, is evidenced by his leadership of the Reforestation Committee of the Associated Advertising Clubs of the World.

PAUL BAILEY's contribution, describing the ingenious plan which has been conceived to restore the equilibrium between water and land in the great interior valley of California, will be read with interest not only in that state, but by engineers everywhere, for it represents a truly unique project in the history of irrigation engineering. Mr. Bailey is deputy state engineer of California.

D. W. SULLIVAN is an irrigation executive of broad experience and keen interest in the problems of management and engineering. His short article describing the work which his company has done in repairing irrigation ditches is a practical suggestion for many who may be faced by similar problems.

W. M. MERTZ is a well-known citrus grower of Southern California, with interests in several parts of the state. His home is in Ontario. The article on the merits of the application system for citrus irrigation is the first part of a paper which he recently presented to the Citrus Institute, the second installment of which will be ready for an early issue.

CARL WILSON, Sc. D., is a graduate of Yale University, who has spent his professional career in the study of the problems of domestic water supply from the standpoint of the bacteriologist and chemist. Twenty years of this time he has been a resident of Los Angeles, and for twelve years has been connected with the city water department. His practice has made him conversant with water supply conditions obtaining in practically every part of the western United States and Mexico, and as the head of the largest and best-equipped laboratory in the west, he is contributing largely to the advancement of that important branch of water-works knowledge.

HANKINS & HANKINS, San Francisco attorneys, who regularly conduct for MODERN IRRIGATION the department devoted to legal and judicial matters, are attorneys for the Glenn-Colusa Irrigation district, and are specialists in this phase of law.

JOHN DWIGHT NEALE is identified with the J. R. Mason Company, leading irrigation security dealers, and is a crusader in the interests of irrigation and reclamation credit.

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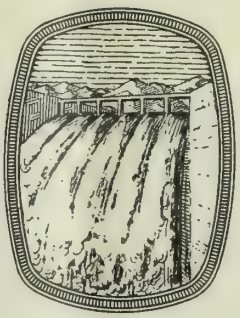
OWEN D. YOUNG

Chairman of the Board of Directors of the General Electric Company; an international figure by virtue of the service which he rendered in connection with the post-war economic rehabilitation of Europe, and a dominant personality in the large and powerful group of corporations known generically as "the power companies." Addressing a convention of public utility executives, in May, Mr. Young made a statement touching the attitude of the power interests toward future development of the country's water resources that has been regarded a most significant pronouncement.

MODERN Irrigation
The Magazine of Applied Hydraulics



Volume II JUNE, 1926 Number 6

The Progress *of* Irrigation

AGRICULTURE is apparently on the up-swing of prosperity. Although there is much talk of "helping the farmer"—talk which probably will materialize in nothing more than good advice, or, worse, some uneconomic expedient for exchanging public moneys for farmers' votes—the farmer seems to be well on the way out of his slump and quite well able to help himself. Especially is this true as regards the far west.

A recent observer, writing of the farm market in the western states, cites a gain of $16,000,000 in the value of California farm products produced in 1925 over those produced in 1924, and says:

"Best of all, the recent agricultural improvement seems to have included not only all of California, but also the entire northwest and southwest. Even Idaho and Montana, almost ruined during post-war depression, have staged one of the most remarkable business recoveries in history. A recent survey of Idaho, Oregon and Washington disclosed a gain in farm purchasing power of more than 25 per cent."

Another observer points out an obvious trend toward breaking up large holdings of land in the far west, of which the recent subdivision of the tremendous Miller & Lux properties was typical, and comments: "The rapid increase in the *number of farms* throughout the west is probably the most significant development in relation to the present trend of agriculture."

Much of the credit for this renascence of farm prosperity in the west must be ascribed to irrigation; and that includes not only one phase of irrigation, but all phases—adequate financing, able engineering, strong organizing, competent management, and careful husbandry. At the same time it augurs well for irrigation's further advance. The rural west is entering upon a favorable aspect of the business cycle, and irrigation will flourish as a result.

OWEN D. YOUNG, chairman of the Board of Directors of the General Electric Company, who became an international figure as America's representative in councils for the economic rehabilitation of Europe, made a statement in May before the annual convention of the public utilities companies that will be read with deep interest by every one who appreciates the immense importance of what the "power companies" think about the development of the nation's water resources.

Mr. Young made an appeal for a broad national outlook on the part of both the corporations engaged in the development of power and the advocates of government water developments, and for the destruction of the animosities and misunderstandings that have clouded the relationships of these varied agencies of development and conservation. He said:

"While this debate goes on, vast rivers go unharnessed for power, waterways are undeveloped, floods drown us and droughts devour us. May I not call for a broader view in the public interest from the representatives of both the utilities and the public? Can we not find a way by which the sovereign powers of the states may be recognized in the location, construction and ownership of these tremendous structures in great rivers supplying government services as well as power?"

Mr. Young pled for a recognition, on the part of the factions too often opposed, of the part played by each other in the necessary development of the waters of the nation. This is a significant indication of a conviction that what can not be accomplished by either when they are in violent opposition, might well and wisely be accomplished if they were in harmonious agreement.

The key thought of his remarks was the hint that many of the objections to public ownership which, from time immemorial, have been urged against government development, may not be valid in the case of great rivers, international or interstate in ownership, where flood-control, navigation, irrigation and power are correlative objects. In his address as reported in the New York press, he said:

"Where vast rivers, either on international boundaries or within the United States, require development for several purposes, such as navigation, irrigation and flood control as well as for power, there arises a new kind of question which is wholly unrelated to the old controversy of government vs. private ownership."

AS HAD BEEN generally predicted by this magazine and other observers, the Boulder Canyon Project Act, fathered by Senator Johnson and Congressman Swing of California, was passed over without definite action until the second half of the Congressional session, which meets in December. The particular hurdle on which it faltered, after successfully clearing the barrier of the Senate committee, was the House Committee on Irrigation and Reclamation. On May 22 the committee adopted, by a vote of 9 to 6, a motion to postpone consideration of the measure "without prejudice" until the next session.

The motion to defer consideration was offered by Representative Carl Hayden, of Arizona, and he was supported in the vote by the Democratic members of the Committee and two Republicans. The vote on the motion for delay was:

> For—Hayden of Arizona; Hudspeth of Texas, Lankford of Georgia, Reed of Arkansas, Allgood of Alabama, Whittington of Mississippi, Morrow of New Mexico, Democrats, and Leatherwood and Allen, Republicans.
>
> Against—Smith of Idaho, Leavitt of Montana, Winter of Wyoming, Swing of California, Arentz of Nevada and Davenport of New York, Republicans.

Although the proponents of the Swing-Johnson bill have denounced the action of the house committee as an example of "playing politics" with a national, non-political issue, charging that the congressmen feared to take action because of its possible reflection in the coming congressional elections, neither its advocates nor its opponents regard the resultant delay as particularly significant. Its effect is merely to postpone action, which would probably have been postponed anyway, for one reason or another, until the latter half of the session.

THERE has been a large spring rainfall in many parts of the west, especially throughout California. As a result, paradoxical as it may seem, there is an increased forest-fire danger to be faced in these regions during the summer months.

George H. Cecil, forest supervisor in California, has broadcast a general warning of this situation, explaining the effect of the heavy rainfall in adding to the fire hazard.

"The more rain, the more fires," says Mr. Cecil. "This may seem contradictory to the casual observer, but it is nevertheless the truth. The splendid rains, so many of which came late in the season, gave new life to the forests' undergrowth and the wild grasses, causing the latter to grow to unusual lengths. Recent dry winds, passing over these grasses and weeds, have caused them to go to seed and die early.

"Experience teaches us that this growth, beautiful and welcome as it is when fresh and green, constitutes an extraordinarily bad fire hazard later in the season."

Of all classes of men, irrigators and irrigationists should be most alive to every factor which affects the forests, the source of the material which is the alpha and omega of the irrigation industry. While they are always on the alert to make their influences felt on behalf of protecting the forests, they will be especially active during the season of 1926 on account of the increased need.

Cotton is King – but *Irrigation* Is the *Power* Behind the *Throne*

Water Plays Leading Role in Creation of Great New Western Industry in the San Joaquin Valley and Constitutes Major Item in Production Cost

By H. N. CARROLL

WATER, most of it pumped, is playing the leading role in developing in the great interior valley of California a tremendous cotton growing industry. The cotton grower must take careful thought for his irrigation supplies, for, although it is irrigation that makes the successful production of cotton possible in this region, water and the labor of its application also constitute one of the largest items in the cost of growing and picking the crop.

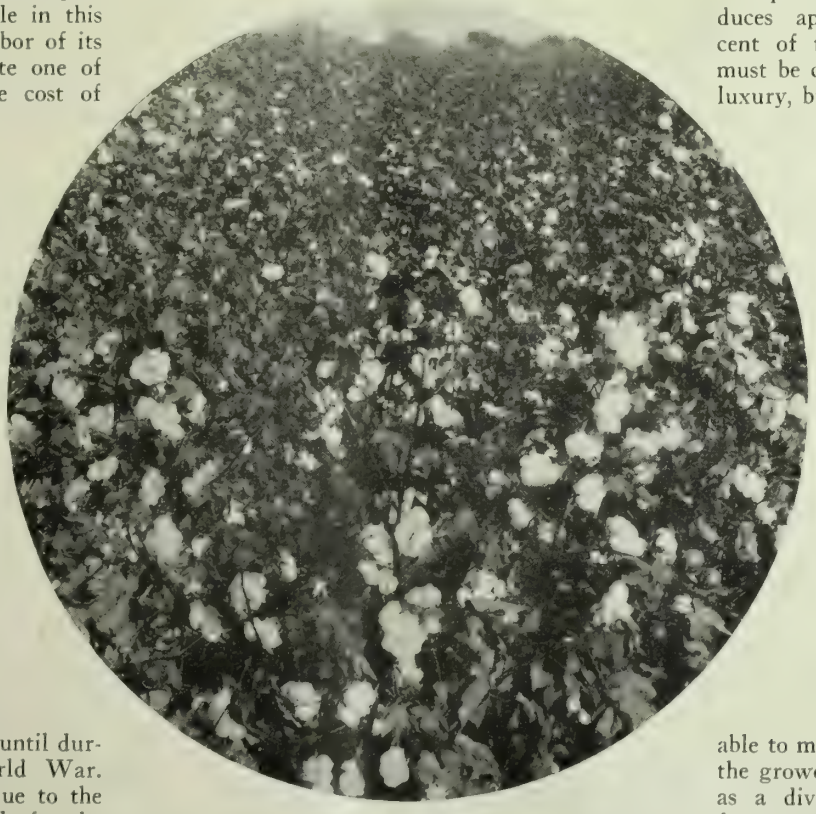
Great interest has recently been aroused in the cotton-growing possibilities of the San Joaquin Valley, and some of the publicity attending this widespread interest has tended to give the impression that cotton is an entirely new crop to this region. This is not true, however, as public records show that cotton has been grown in the San Joaquin Valley in varying quantities for the past 25 years.

It is true, however, that it was not grown in commercial quantities until during and since the World War. This was undoubtedly due to the fact that it was impossible for the cotton grower of the San Joaquin Valley to compete with cheap negro labor and natural rain-fall conditions of the big cotton growing states of the South in the days before 1914, when it was possible to contract cotton chopping to negro labor for 50 cents an acre, and when all other labor in connection with the growing of this crop was in exact proportion.

These were the days when cotton could be raised for from 5 to 10 cents a pound, and commanded from 5 to 10 cents per pounds in the open market. Those were also the days before the destructive ravages of the boll weevil, an insect that has extracted a greater toll from the pockets of the American public than any other insect pest in the history of the United States.

"Overproduction" Idle Talk

In 1923 the valley harvested a crop of 10,000 acres of cotton; in 1924 this acreage had risen to 38,000 acres and jumped to 98,000 in 1925. Such has been the increase that it has already given rise to the cry of over-production, but the people who claim that there is any danger of the present acreage of cotton in the San Joaquin Valley in any way influencing the market have not examined this subject very closely. The average world production of cotton is upwards of twenty million bales annually, and this year, with a potential 80,000 bales, the San Joaquin Valley would have only three-tenths of one per cent of the total crop of the entire world.



A San Joaquin cotton field—there were ninety-eight thousand acres like this in the valley in 1925—and more coming.

If the valley produced 200,000 bales of cotton it would still have less than one per cent of the world's production. We, in the San Joaquin Valley, when we speak of over-production, are prone to think in terms of fruit and especially raisins. When we do this we are speaking of an area that produces approximately eighty per cent of the world's crop, which must be considered also as a semi-luxury, but when we speak of cotton we speak of a commodity for which new uses are continually being found and which has become an absolute necessity for civilized man.

The great danger to the San Joaquin Valley is not that it will produce too much cotton, but in the temptation, which always comes in periods of peak prices, to develop a one-crop area. There will come, as there comes to all agricultural producers, a year when the cotton grower raising cotton on a large scale and hiring labor for its production will not be able to make both ends meet. But the grower who is growing cotton as a diversification of his other farm activities, and who in all probability will be supplying most of the labor for its production himself, will even in those times be in a position to make money on his cotton.

One often hears talk of 500,000 and 1,000,000 acres of cotton in the San Joaquin Valley. There are, however, at least two reasons why this acreage will undoubtedly never be reached. These two are sufficient no matter what others there may be. There is not the available water nor labor for production on any such scale. Nevertheless the greatest good that can possibly accrue to the San Joaquin Valley from the production of cotton will come only in the exact extent to which we use cotton as

Four stages in the production of cotton. LEFT—Planting the crop. RIGHT—Weighing pickers' cotton in the field.

a diversity factor on San Joaquin Valley ranches.

How Irrigation Figures

Most of the cotton in the San Joaquin Valley has been grown under pump irrigation. Even on ranches where ditch water was available this supply has in most cases been supplemented with pump water. Cotton must have water at the proper time if the best results are to be obtained and it is not advisable to take chances on the source of supply. A survey conducted by the San Joaquin Light and Power Company, Fresno, two years ago to determine the conditions under which this crop was being grown showed the average pumping head to be 77 feet. Last year, however, the development of cotton culture spread to portions of the Valley where the pumping head was lower. It is very doubtful, however, if the average head has been reduced as there was also a considerable increase in acreage in the high head territory in both Fresno and Kern Counties. At the present time the cost of water represents from 5 per cent to 10 per cent of the actual production costs for this crop whether grown with pump or ditch water.

It is very easy to obtain widely divergent figures on the cost of growing cotton in the San Joaquin Valley, and the following estimate of costs was prepared by checking up the various individual items and then using the highest unit costs furnished by growers. For example, allowance was made for 2½ acre-feet of water, while the amount of water applied in average soils is only 2 acre-feet. At the cost included, this water was figured against a 77-foot head, when the average head for the Valley is approximately 35 feet. Allowance was made for 2 cents per pound for picking, and the price paid this year was 1¾ cents. Forty cents per cwt. was allowed for ginning and cotton is being ginned for 30 cents per cwt. Seven dollars per acre was allowed for chopping or thinning the crop, when the average will be between $4.00 and $5.00. These costs were based on a production of 1200 pounds of seed cotton, or approximately ¾ of a bale per acre, which would make 375 pounds of lint and 825 pounds of seed. This gives a production cost of $60.55 per acre. Subtracting the value of the seed at the average market price of $35.00 a ton, we have a cost of $45.56 for 375 pounds of lint, or approximately 12 cents per pound.

ESTIMATED COST OF COTTON PRODUCTION IN SAN JOAQUIN VALLEY

Preparing and Planting Land		
Irrigation	$2.00	
Plowing & working down	5.00	
Seed	2.00	
Seeding	.55	$ 9.55
Growing the Crop Per Acre		
Chopping and Hoeing	7.00	
Cultivating	6.00	
Irrigating	4.00	17.00
Harvesting and Marketing		
Picking @ 2 cents	24.00	
Hauling	1.50	
Ginning @ 40c per cwt.	4.80	
Bagging and ties	1.75	
Insurance	2.00	34.00
Total		$60.55
825 lb. seed @ $37.00 a ton		14.99
Cost of 375 lb. lint		$45.56

It must be quite apparent to anybody on the outside looking in, that the San Joaquin Valley's newest baby is in a very prosperous condition. This fact is best attested by the rapidity with which facilities for handling this product have grown in the past three years.

There are today in the Valley thirty-two Gins, five Cotton Oil Mills, and two Compresses, which represent, at a very conservative estimate, one and one-half million dollars in permanent buildings and machinery for handling the crop. In view of the fact that practically all of these investments were made by men who have been in the cotton game for years and are thoroughly conversant with the pitfalls and dangers that attend the development of new industries in new localities, it must be con-

(Continued on Page 40)

LEFT—A modern gin. There are thirty-two of these in the Valley. RIGHT—A stage in the process of baling.

Oklahoma is *Waking Up* to Its Conservation Needs

Unique Problems Joined to Big Opportunities in Comprehensive State Program to Serve Flood Control, Drainage and Irrigation

By E. E. BLAKE

Commissioner of Drainage, Irrigation and Reclamation, State of Oklahoma

E. E. BLAKE

INTELLIGENT use of water has been advocated and resented in Oklahoma since 1889. In times of winter dryness, moved by suffering grain crops; in times of summer drought, moved by burning and curling crops, dying trees and scorching pastures it has been advocated. In times of spring floods and autumn torrents, by those whose hopes were insulted, and whose "fertile soil" was thereby slandered, it has been resented.

Nine years were required to get a "water right" law in Oklahoma; twenty-three years were required to get a "water right" allowed. Even then, the law did not make the organization, or financing, of an irrigation district possible; private irrigation was not indulged; co-operative attempts were, as usual, abortive and futile.

Staggering Water Waste

Meantime, each year, there ran from Oklahoma lands probably twenty million acre feet of useful water,—probably as much as has made California glorious, or Utah possible, or Colorado populous. The water, in its going, washed much fertility from the Oklahoma soil and, with it, carried the destruction of property of an average annual value of ten million dollars—reaching an apex of destruction in 1923, when the property loss from floods was over $100,000,000.00, and the life loss equal to the Pueblo flood; and when every means of earthly transportation and communication across the state was destroyed for fifteen days.

This brought the attention of the people of the state to its waters, theretofore largely unnoticed. A study of the rivers of Oklahoma discloses that they are unique, apparently the only ones of their kind. Running in the west on a gradient of many feet, per mile, over a heavy sandy bed, decreasing to a gradient in the east of a few inches per mile over a former rocky and clay bed, they form a section of a parabola down which the accumulating waters of torrential rains of wide area rush with slowing speed and increasing elevation as they go.

Repeated efforts to secure a conservancy district law failed, until the 1923 devastation (occurring when the legislature could see it) urged the passage of an adapted form of Ohio conservancy law that provides for the districting of an entire stream system as a unit and the distribution of the costs to the farthermost reaches to which the benefits may be traced. An appropriation of $50,000.00 was made to investigate, map, and submit proposed conservancy districts, and a Commission was created to look after it, to negotiate interstate compacts looking to the control of interstate streams, the division of the costs, the allotments of benefits, and the apportionment of waters of beneficial uses.

Many streams are the present subject of study. One stream 400 miles long has been developed to a sufficient extent to indicate the possibilities; cities, counties, engineering schools of the university, and the A. & M. College, the railroads, and many public-spirited engineers and citizens aiding in the work.

It is disclosed that about 500,000 acre feet of water outside of that stream channel capacity, in one week destroyed $25,000,000 worth of property, interrupted every railroad, highway, and transmission system in the state. The flood waters swept the entire valley from hills to hills, so no valley control could be had. Restraint looked to be the only solution to be adopted.

Locate Reservoir Sites

Developing this idea, a scout disclosed about 100 possible large reservoir sites which were investigated. Of these, 43 were temporarily adopted and worked out as the most appropriately located, most efficient, and most economical. Two of them were located on the main prongs of the river where it entered the state; the others in tributaries, all being properly spaced throughout a course of four hundred miles so that the uncontrolled waters to be expected from the water-shed should not, in any place, exceed the channel bank capacity.

Two sites called for a diversion where nature had provided easy diversion canals, one capable of 10,000 second feet flow, emptying into storage of 200,000 acre feet, all at a cost of about $8.00 per acre foot. The other diversion is carried 14 miles, largely through natural channels, and cares for 270,000 acre feet, at a cost of less than $8.00 per acre foot.

A safety ratio of 3 to 1 was adopted over the flood requirement of 1923, and a storage control of a million and a half acre-feet of water was contemplated. Dams of earth and rock, with concrete core, extraordinary spillways, and adequate discharge gates, all of the highest type of engineering, were calculated, and the material and work submitted for estimates of cost to fourteen construction engineers experienced throughout the middle west.

Cost Estimated $8 per Acre-Foot

The estimates of the engineers, while differing on specific elements, when aggregated exceeded by only 2 per cent the estimate of the engineer in charge, which showed a probable cost of about $8.00 per acre foot of entire storage capacity contemplated; providing of course the entire 43 suggested sites would thereafter be adopted by the district. The average construction cost per acre-foot of storage was $8.00, or a total of $12,000,000.00 for the entire project, provided of course the district should adopt the entire project.

Under the law, the district may adopt all of it, or any part of it, or change the suggested plans according to their best engineering advice, subject to the approval of the court, after due notice to each person charged, and hearing.

To cover all contingencies unforeseen, overhead, and other expenses, including

calamities, fifty per cent was added, and the announced estimate of $18,000,000 for the one and one-half million acre-feet contemplated storage (or a rate of $12 per acre-foot) was given out. Compared with $50 property destruction by each acre-foot of wild, ravaging water in 1923 alone, this looked economical and advisable, and it was submitted with the explanation that the district, when organized, could utilize that plan, or any part of it, or any modification of it, or any other plan deemed more acceptable by the district authorities. This work-out was only urged as being a provable demonstration that at least one adequate plan was possible and justified the temporary creation of the district for the purpose of more complete investigation and the proving, or disapproving of the engineers' work; that, if verified, it was advisable that the work should be done.

The data, completed and calculated, seemed to prove that this control of this particular stream would protect twenty railroad crossings and affect every railroad in the state; protect the roads, bridges and transportation of eighteen counties; one hundred and ten townships; one hundred and thirty school districts; the water works and parks of five cities; about 800,000 acres of agricultural lands, and about 2,000 town lots, suggesting an increase of taxable value of more than $300,000,000 and a saving of annual average public expenditures to repair flood destruction of several million dollars. This would afford protection to the state, and its municipalities and administrations, to the state and federal highways, to bridges, the transportation of mails, telegraph, telephone, gas, oil, and other public facilities, and would preserve communication and transportation in the state.

Huge Saving May be Effected

The value of property protected, outside of agricultural lands, was estimated at $600,000,000. A board of thirty-eight appraisers from various walks of life (volunteer and unofficial) arrived at an estimate of benefits exceeding $200,000,000, and allotted the estimated cost of $18,000,000 in proper ratio thereto. A study of the results showed that about 50 per cent had been allotted to public municipalities, about 25 per cent to corporate and unlanded properties, and about 25 per cent to the agricultural lands and town lots, which, strange to say, followed closely the actual results as allotted in the Miami, Ohio, conservancy district.

This ended the work of providing for the conservation of the water. Its beneficial uses were next studied. There being a contemplated capacity of 3 to 1 as to requirement in most of the reservoirs (as measured by 1923 flood, whic was the highest known in historic time) it was carefully considered how much of the gross temporary restraint could be safely impounded for other uses. It was finally arrived at that dependable water could be held, without endangering the flood control uses of the reservoir, for over 100,000 acres of irrigable land.

Some estimates assert that 500,000 acres of irrigation could be reached, and assured, within five years of wise and cautious administration.

Oklahoma's Situation Peculiar

In this, many elements peculiar to Oklahoma were considered: climate, normal rainfall of 30 to 40 inches, as disclosed by thirty-one years of observation; the great territorial length covered by the project; the dependable continuous flow of the rivers and creeks; the ease and cheapness of interlacing the separate reservoirs by extension of the main distribution canals; the character of the soil; nature of the crops; and the probable development of desires for use and application of water as experience educated the customers. In this enters a condition apparently peculiar to Oklahoma.

The west half of Oklahoma is a prairie country. The declination of the state is to the southeast, the average fall being about ten feet per mile in a direct line, and the streams generally much below the general surface plane. The land is not horizontally stratified, but has been a vast silt deposit and has what is called a "perpendicular grain." It absorbs water like a lamp wick, and returns it slowly to the surface. This characteristic accounts for the long drouth-resisting power of Oklahoma's crops, and in fact, makes crops possible in spite of the long intense drouths which afflict the state both winter and summer.

It was considered that this would permit the watering of deep-rooted plants like alfalfa, orchards, nuts, etc., at long intervals, probably in the winter alone, saving the summer waters for more superficial crops. This was deduced from experience in certain known instances. Correspondingly, surface crop ground once saturated was calculated to go longer between waterings than under the usual conditions common to irrigation countries.

Drouth-Resistant Plants

In addition, Oklahoma has developed through necessity many semi-arid drouth-resisting crops unknown in irrigated countries and not usually considered by engineers in arid sections. All things considered, it was felt that the irrigation possibilities from this one conservation would run somewhere between 100,000 and 500,000 acres, as far as man is able to contemplate and conjecture unexperienced conditions.

This water could be sold as a water right basis for $30 per acre, which would mean a return to the district (which will own the water) of from three to fifteen million dollars, or a goodly portion of the total cost from this one source. If the water were sold on a service rate of so many dollars per acre per annum, it could reasonably be expected to return from one-half million to two million dollars per annum, assuming a normal rainfall. There are other sources of return from the water, not contemplated herein, as the water could all be released under a control head and could be easily recaptured thereafter in lower basins and re-used. This is due to the unique topography of the country, which, study discloses, affords most unusual and economic possibilities of storage.

Six Million Acre-Feet Held

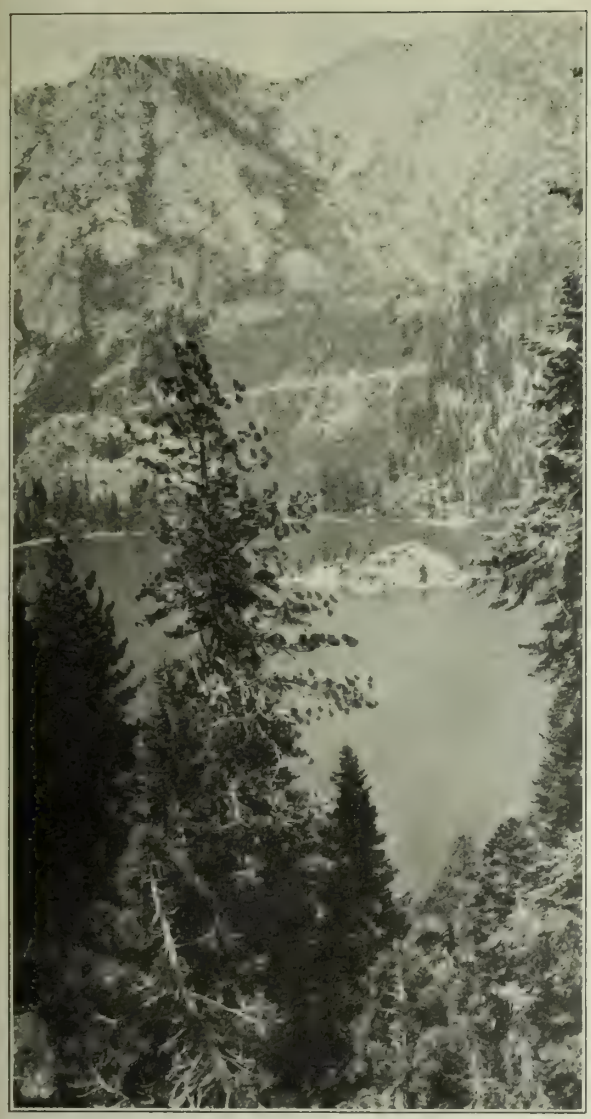
On other streams, investigation discloses that as much as six million acre-feet of water can be held per annum, dependably and with safety for all purposes desired, (for flood and otherwise), at a probable actual cost of about $6.00 per acre-foot for construction. Notably one project, as developed, indicates a two-million acre-feet impoundage of a 149-feet head maximum, with a usable minimum discharge of 6,000 second-feet throughout the year, and this project has a calculated construction cost of $3.00 per acre-foot.

This project also protects from flood, (and could water, after discharge) about 200,000 acres of rich bottom land, which is now frequently ravaged by floods, at present worth only about one-fifth of its estimated worth after protection; and about one-tenth of its worth if it were both protected and watered. This looks advisable. Other projects approach these results, and it might be interesting to know that the highest estimated cost of any so far adopted Oklahoma reservoir is $16.75 per acre-foot.

These projects, as so far partially developed in this, the first year of the Commission's work of gathering material and information, indicates that, at an expense of $36,000,000, or about what the Miami District cost, there could be protected from floods of the river valleys of Oklahoma, approximately two million acres of now damaged or destroyed rich bottom lands, more than a billion dollars' worth of unlanded property, and that such development would (as calculated) make available for various uses six million acre-feet of water, from which at least one million acres of land could be assured of dependable and needed irrigation.

A. S. A. E. Meeting Will *Feature* Reclamation

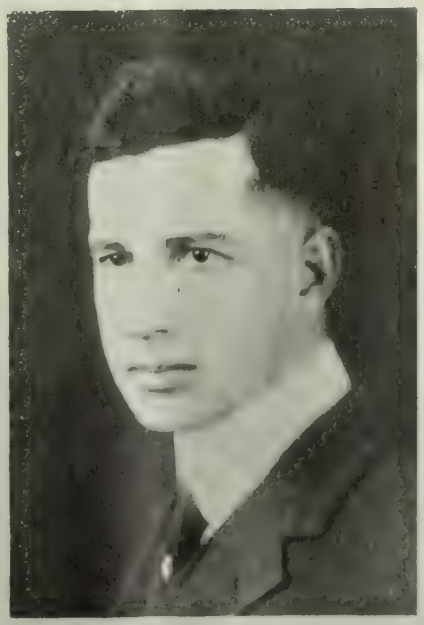
Soils and Soil Moisture Will Be Subjects of Prime Interest at Lake Tahoe Sessions of National Society, June 23-26



Beautiful Lake Tahoe, where the Agricultural Engineers will gather in Annual Meeting late in June.

WHAT reclamation engineers should know about soils, and the relationship of soil moisture and plant growth to irrigation, are to be discussed during the morning of Friday, June 25, at the 20th annual session of the American Society of Agricultural Engineers, in Tahoe Tavern, Lake Tahoe, California. These two subjects and a discussion of the problems of settling reclamation projects will comprise the program of the division of land reclamation.

"A newly insistent demand is being made upon reclamation engineers to possess or acquire a knowledge of soils," according to Major O. V. P. Stout of the Division of Agricultural Engineering, U. S. Department of Agriculture, and Chairman of the Land Reclamation Division of the Society, who will head a symposium on "The Soil and the Engineer."



F. J. VEIHMEYER

Prof. F. J. Veihmeyer, of the Division of Irrigation Investigations and Practice, University of California, will read a paper on "Irrigation in Relation to Soil Moisture and Plant Growth." A paper on selecting, financing, and guiding settlers will be presented by J. V. Mendenhall, President of the Holland Land Company, under the title "Wanted, an Agricultural Engineer." Dr. Elwood Mead, Commissioner of Reclamation of the United States Bureau of Reclamation, will also address the meeting on "A National Reclamation Policy—What it Should Include," and many other engineers prominent in the reclamation and settlement of lands will take part in the discussions.

J. V. MENDENHALL

Major Stout's symposium will give views of authorities on such matters as the nature and extent of the knowledge of soils with which engineers in various phases of land reclamation should equip themselves, where this knowledge can be found, and the circumstances requiring its application.

Professor Veihmeyer's paper will discuss certain phases of the movement of soil moisture, losses of moisture by evaporation from the surface of the soil, and the effect of cultivation on the control of soil moisture. The amount of loss of water by evaporation has been found not to be affected by cultivating the surface in the absence of weed growth, and the distribution of water in the soil likewise is not affected. Some basic conceptions of the relation of soil moisture to plant growth will be presented.

The rate of use of water by plants under different soil-moisture conditions, the wilting of plants, the relationship of soil-moisture to absorption by plants, and the physiological response to different amounts of available soil-moisture are all topics of vital importance in all water requirement, or so-called duty of water studies.

Irrigation Under

A High Degree of Has Been Attained

Island Sugar Industry Depends on Irrigation for its Very Existence

A WORLD rain-fall record of nearly 600 inches for one year comes from the Hawaiian Islands. This excessive rain-fall, however, is in the mountains of the Islands and it does not follow that irrigation is unnecessary. Some of the forty-eight sugar cane plantations, which average three or four thousand acres in area, have an annual rain-fall of only a few inches, although they are within a few miles of the mountains where it is raining almost continuously.

This peculiar situation makes irrigation the logical sequence in the production of crops on the gentle leeward slopes of these magnificent islands. Long ditch systems have been constructed in the mountains to catch the numerous streams and lead them to the plantations. The cost of ditch construction is great, much concrete, tunneling and flume work being generally required. The water is, therefore, costly, and during the past few years the plantation owners have come to realize that this water must be cared for as they would care for their bank accounts if they would avoid wastefulness and obtain maximum crop returns.

Sugar cane is the one outstanding irrigated crop in Hawaii. Altogether there are some 125,000 acres planted to cane, seventy-five per cent of which is irrigated. From 18 to 22 months are required to produce a crop of cane and during this time it is irrigated at seven to twenty-day intervals excepting during the rainy season. Frequently as much as six acre-inches are applied per irrigation and usually not less than four acre-inches are used. A crop of cane may require as many as thirty irrigations and twelve or fifteen acre-feet of water per acre before it is brought to maturity. It is, therefore, evident that the accurate control of the irrigation water, which in some instances is valued at $15 and $18 per acre-foot, is an important issue on the Hawaiian sugar plantations.

Furrow Irrigation

Furrow irrigation of sugar cane is the principal method of field application. It is a combination between the furrow and the contour methods of the States. The cane is planted in nearly level rows 3 feet apart. The furrows between, which are eighteen inches deep, take their supply alternately from ditches running at right angles to the rows, about 100 feet apart. When these furrows are filled with water the furrow gate is closed and the supply diverted into another furrow below. There are variations in the cane furrow application. Sometimes they zig-zag back and forth two or three times when the ground is sufficiently level to allow the water to stand at a uniform depth. Another variation is in the location of gates between furrows to allow the water to pass from furrow to furrow. These are usually in series of eight or ten to permit uniform application.

Overhead irrigation is being tried out by some of the leading plantations. The Hawi Mill Plantation on the northern portion of the Island of Hawaii had about 100 acres under the sprinkler system at the time of the writer's first visit. John Hind, Jr., the manager, was enthusiastic about its success. Although the cost of laying pipes is $150 to $200 per acre Mr. Hind believes it justifiable due to the saving in irrigation labor,

Scenes and structures in the Hawaiian Islands.

ABOVE — Seventy-two inch syphon, Oahu plantation, near Honolulu.

LOWER — Typical tropical vegetation, a flume in the background.

HEADING—A touch of haunting beauty from an island beach.

Tropic Skies

Development in *Hawaii*

RAY J. LYMAN
Tells of Advanced and Progressive Practices

this item being cut to less than one-eighth the former amount required. Other advantages claimed are a 40 per cent saving in water, more uniform application, avoiding loss in field area due to ditches, makes day and night irrigation possible, makes cultivation easier due to absence of deep furrows required by the surface ditch method, and makes fire control very effective during the ripening stages of the cane when the fire hazard is great.

The disadvantages of the overhead system have been the great cost, danger of sprinklers not functioning properly due to trash in the water or heavy winds which blow the water out of its intended area.

Modern Construction

Irrigation construction in general is along modern lines and compares very well with that on the best constructed projects in the States. Some of the plantations have many miles of concrete lined ditches. Lateral diversion and spillway construction is in general like that in the States but frequently distinctive designs are to be seen. The division weirs shown in a picture accompanying this article (page 45) on the Hawaiian Commercial & Maui Agricultural Plantations is representative of the individualistic construction resorted to by the Plantation Engineers who are almost always men from American colleges.

Reservoir sites for the storage of water are scarce but small ones are constructed here and there on some of the plantations to facilitate water distribution. Almost every scheme to be seen in America in the distribution of water is to be found in similar form in connection with irrigation in Hawaii. Steel and wood stave pipe lines, syphons, metal flumes, concrete lined ditches, concrete structures of many descriptions, electric pumping plants equipped with high grade machinery, some of which elevate

water as much as 600 feet from wells to the higher lands, tunnels miles in length to lead the water from the northeast steep wet sides of the mountains to the southwest dry slopes. Millions of dollars have been invested in irrigation development in Hawaii.

Plantation System

On my first visit there I was amazed at what I found and wondered how such progressive development had been brought about. The answer was conspicuously clear after my second visit when I had become somewhat acquainted with the men who manage affairs in the sugar production of these islands. Organization is the keynote throughout the sugar industry here and a daring conservative-progressive spirit prevails in the management of nearly every plantation. The spirit of contest among the plantations is to be observed urging toward better system, better production, better efficiency. It is unfortunate we do not have the incentive for this contest spirit on our projects in the States.

ABOVE—View of pre-cast concrete slab lined ditch on Hawaiian Commercial Plantation, Island of Maui. LOWER—Section of lava rock lined ditch of a type frequently seen in Hawaiian irrigation systems.

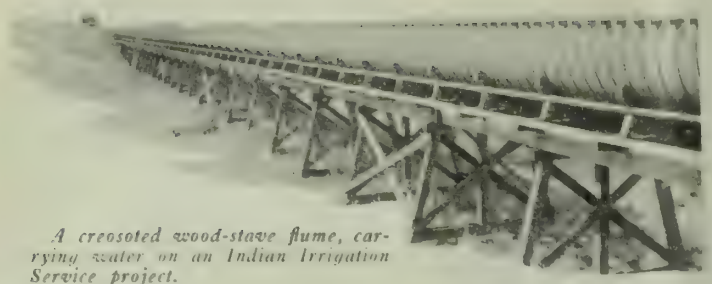
The forty-eight sugar plantations are owned and operated for the most part by five different companies which are more or less inter-related. This organized ownership has been so decidedly business-like that no question has been left undiscussed wherein it involved more efficient production on the plantations. Many years ago an organization of nearly all the plantations under the name of the Hawaiian Sugar Planters Association was created to carry on research in the production of sugar cane. More than forty people constitute the research personnel of this association under the capable management of H. P. Agee. It would probably be reasonable to state that the H. S. P. A. has been responsible for the production of millions of tons of sugar, which would not have been produced had its research work never been done in cane variety improvement and scientific cultivation methods.

Their experiment station located practically within the city limits of Honolulu is a model of neatness and orderly control. A beautiful and spacious building, which is an inspiration to all who visit the station, provides office and filing space for records and specimens as well as an abundance of room for testing equipment and laboratory research along chemical, physical, bacteriological and entomological lines. For thirty years this association has been publishing a quarterly magazine, for its members only, which serves as a distributor of a veritable stream of knowledge useful to the plantation operators.

Water Measurement

The Ewa Plantation on the island of Oahu, 20 miles from Honolulu, embracing about 7500 acres, differs from most of the plantations in its water supply. It depends entirely on wells from which there is pumped 100 to 175 sec. ft. for 9 or 10 months of the year by means of electricity generated in Hono-

(*Continued on Page 45*)



A creosoted wood-stave flume, carrying water on an Indian Irrigation Service project.

The *Indian* is Practical Irrigation

With Uncle Sam as His Teacher

Results Attained by Indian Irrigation Service Admittedly Not Ideal, But Worth While from Many Standpoints

WHEN federal reclamation is mentioned one thinks at once of the U. S. Bureau of Reclamation, which came into existence in 1902. That branch of the government, however, notwithstanding the importance which its irrigation activities have assumed, was not the first to construct irrigation projects. In the year 1867, considerable work was done on the Colorado River Indian Reservation by the U. S. Indian Service and has been continued at irregular intervals from that time on.

In 1904 the project on the Crow Indian Reservation, the first large project to be undertaken in the interest of the Indians, was begun.

The first work was done with a dual object—not only to provide water for irrigation, but to teach the Indians how to work.

Growth of Organization

There was not much of an organization in the earlier days, but an engineer was hired to supervise the work. Later, an Inspector of Irrigation, who was an irrigation engineer, was placed in charge of the work.

About 1902, W. H. Code, now of the engineering firm of Quinton, Code and Hill, Los Angeles, was made chief engineer of the Indian Irrigation Service, and held the position until about 1911. Under his supervision the organization was efficiently built up to handle the work on the various reservations, where the work was under the immediate charge of a Superintendent of Irrigation.

In 1912 the five Superintendents of Irrigation were given special districts. This practice has been continued to date, and the work in each of the five districts is under a supervising engineer who is responsible to the Chief Engineer and the Commissioner of Indian Affairs.

Since the irrigation work was first initiated in the Indian Service, some 170 different projects have been constructed or are now under construction or are waiting for funds. Many of these are very small, like the Mission reservations in California and the various pueblos in New Mexico.

Spend Thirty-Two Millions

The total expenditures made in the surveys and construction, up to June 30, 1925, amounted to $25,287,000 and $7,461,400 had been expended on maintenance and operation.

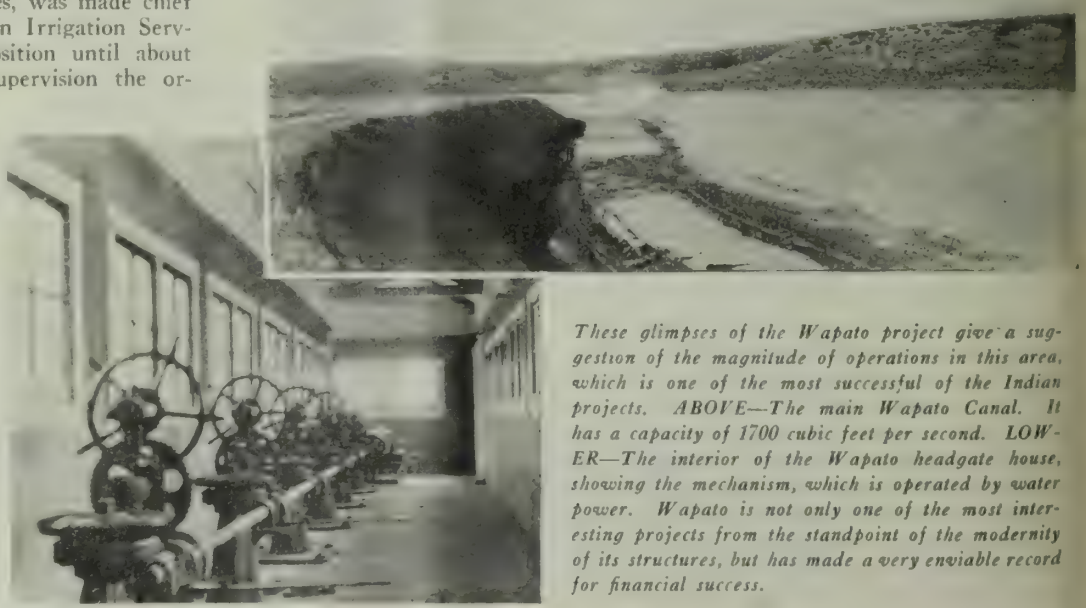
The total area brought under canals by that expenditure is 657,100 acres. There remains some 711,000 acres in projects surveyed and found feasible, yet to be constructed at an estimated cost of $27,351,000. These figures are taken from the hearing before the subcommittee of the House Committee on Appropriations.

There were many interesting sights when the Indians first began to build ditches. It was a significant and yet an amusing spectacle to watch a young brave driving a team of Indian ponies on a slip scraper with one hand and holding a blanket around himself with the other hand, with his long hair flapping in the breeze.

The government has no doubt increased the value of the Indian lands by the expenditure thus far made by at least three dollars for every dollar expended.

Reasons for Disappointment

There are many reasons why the Indians have not done as well as some of us expected. While the results, viewed from the standpoint of ideal accomplishment, may have been disappointing, there is still much to record on the credit side of the ledger. We should appreciate these facts:

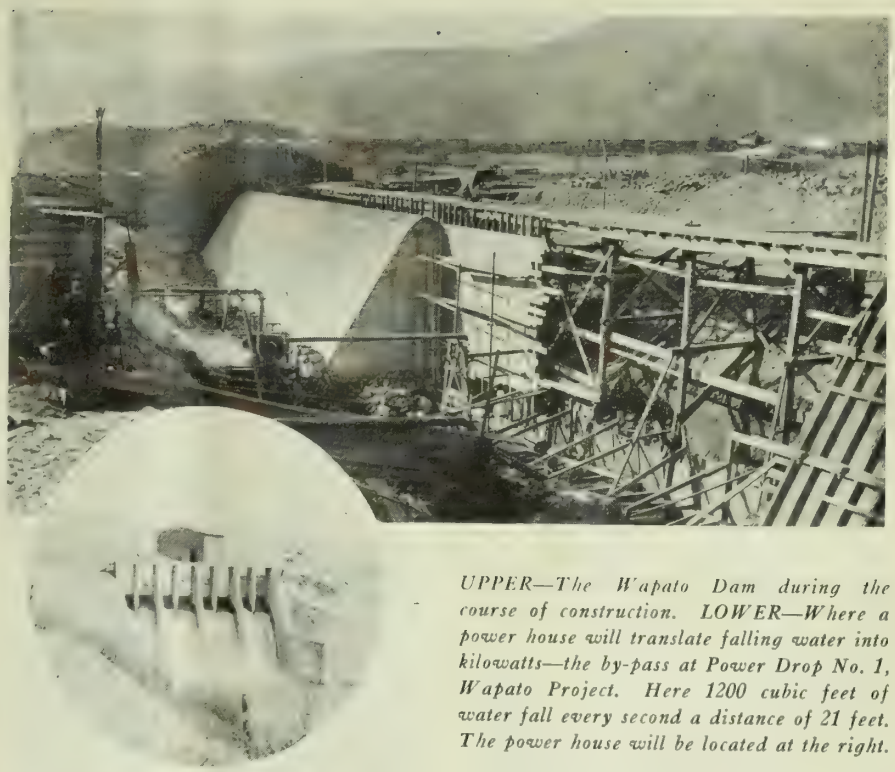


These glimpses of the Wapato project give a suggestion of the magnitude of operations in this area, which is one of the most successful of the Indian projects. ABOVE—The main Wapato Canal. It has a capacity of 1700 cubic feet per second. LOWER—The interior of the Wapato headgate house, showing the mechanism, which is operated by water power. Wapato is not only one of the most interesting projects from the standpoint of the modernity of its structures, but has made a very enviable record for financial success.

Learning Farming

By L. M. HOLT

Supervising Engineer District Number 1, U. S. Indian Irrigation Service



UPPER—The Wapato Dam during the course of construction. LOWER—Where a power house will translate falling water into kilowatts—the by-pass at Power Drop No. 1, Wapato Project. Here 1200 cubic feet of water fall every second a distance of 21 feet. The power house will be located at the right.

1. We often expect too much of an Indian in the way of improvement of his allotment. It takes considerable capital

L. M. HOLT

to construct the necessary building and fences and to clear and level the land for irrigation.

2. The construction on many of the projects has been so slow that many owners have died and as a consequence we have the deceased Indian allotments. These are usually the first ones to be sold to white people.

3. In many cases allotments were made to women and children, and these have usually been leased to white farmers under what are known as "improvement leases," and after three to five years these leases have brought good rentals to their respective owners.

One of the outstanding projects, and one that the writer has been connected with for the past thirteen years, is the Wapato Project on the Yakima Indian Reservation in the wonderfully productive Yakima Valley, Washington, where soil, climate and water for irrigation, are eminently satisfactory, and conducive for success for white man and red man alike.

A large part of the inherited lands have passed into white ownership at good prices to the heirs. These and the rented Indian lands have been examples to the Indians, and while they are not farming in such large numbers as we had hoped, nor quite in the manner that we had planned, there are many very good farmers among them. About 500 are farming themselves and 1500 more are receiving benefit by leasing their lands.

This project, when completed, will irrigate 120,000 acres of allotted land. Last season, with less than 80,000 acres irrigated, it produced a crop valued at $8,000,000.00.

This project is interesting in other ways. The estimated cost is $50.00 per acre, including drainage and storage water for part of each allotment. The drainage canals were constructed at the same time the canals and main laterals were built and often the two were built with one operation by the use of dragline excavators.

Wapato Is Self-Supporting

This project is also interesting for the reason that even in its incomplete state it has been self-supporting for several years and has had no farmers, either Indians or whites, who have become delinquent in the payment of maintenance and operation charges; and, according to the report contained in the "Hearings before Congress" mentioned in the foregoing, it has reimbursed more of the construction charges than all the other Indian projects combined. This in itself is an enviable record for any irrigation project.

The demand for land on this project has, with the exception of 1922, 1923 and 1924, always been in excess of our facilities for supplying irrigation water, due to lack of funds for construction.

Great Transition Required

On many of the reservations the Indians have had to change from stock raising and various other industries to an agricultural mode of life, and their progress has naturally in many instances been very slow, because of the enforced transition.

There were many instances, years ago, where the Government was criticised for not protecting water from reservation streams or boundary streams for its Indian wards. Today there is less room for such criticism, for considerable work has been done to protect these waters by construction and beneficial use.

Taking everything into consideration, including such factors as the length of time construction has been under way, the work accomplished in protection of the waters for the Indians where parts of the reservation have been thrown open, and the increased value of the Indian lands, as the result of the service's work, the results obtained seem to justify the expenditures made.

Ground-Water Studies Should Pave Way for Developments

Services of Expert on Sub-Surface Conditions Will Make Success Surer for Practically Any Water Project

By HYDE FORBES

PART II

THE FIELD for the trained ground-water hydrologist is ever widening. For example, industrial processes in metropolitan areas frequently require water in excess of that which can readily and economically be obtained from the municipality. In such cases it may prove invaluable to be able to obtain water, of sufficient quantity and desirable quality, from wells on a property designated as a factory site. It is therefore incumbent upon the owner of such a tract to have an investigation made and a report prepared dealing with this advantage if he wishes to make a sale. The knowledge that such water is available enhances the value of the property. Similar reports are of value in the case of the projected sale of suburban estates, for residence purposes, which are not supplied by municipal water systems.

In the case of agricultural land in the West the available water supply is the all-important factor. Many irrigation enterprises and municipal and domestic supplies are dependent wholly upon ground-water developments, and some of the largest of such enterprises depend in large part upon ground-water supplies. Future projects will depend more and more upon such sources. The reclamation of swamp and overflow lands is essentially a problem in ground-water hydrology, as is the drainage of irrigated areas, and so on over an ever widening field. Hydrologists are frequently called upon by banks and bond houses to investigate and report upon the available ground-water supply for tracts or areas upon which mortgages are sought or bond issues are expected to be sold for the purpose of funding agricultural development.

Reservoir Losses

Another application of ground-water hydrology is its relation to the probable loss of impounded water from a reservoir site through seepage and ground-water drainage. Costly errors have often been made by engineers who have advised the acquisition of reservoir sites, and have constructed dams only to find that the impounded water escapes underground. A knowledge of the geology of the reservoir site, the detection of the presence of aquifers of high permeability, and the application of the principles of ground-water movement, would have forestalled many such financial losses. Reservoir sites have been selected which presented perfect dam sites, large capacity for low dam heights, and other elements looked for by the engineer, but which the ground-water hydrologist would necessarily abandon because of factors which would allow unreasonably large seepage loss.

As the work of the ground-water hydrologist becomes wider-spread and his advice more generally accepted with confidence by engineers, it will be found that in nearly every problem in water supply, irrigation, and drainage, a primary investigation may indicate precautionary steps to prevent damaging modifications of ground-water conditions. If there be a choice of development plans, the one most favorable to low financial or other losses can be recommended.

Geologic Structure Important

Let us continue the consideration of the impounding of surface waters. Numerous examples of high efficiency (in that a large percentage of the water entering a reservoir is available for use) can be cited where a reservoir site is composed of granite, shale, natural sinks which have been covered over by the precipitation of fine material and cemented through concentration and precipitation of soluble salts through evaporation of the surface waters, etc.; while serious losses, of as high as 75 to 90 per cent, have been found to exist at reservoir sites composed of lava beds with strata of tuff or cinder interbedded, alluvial materials, soil coverings with sandy or gravelly substratum, etc.

The geologic structure is an exceptionally important feature of reservoir and dam sites. Where the stratification dips away from the reservoir site toward a drainage line in an adjoining watershed, the added hydrostatic head will cause serious excess seepage which, with the mechanical work of the percolating water opening larger passages, will increase in volume rather than decrease. In some cases "dikes," which mark especially good dam sites and are generally considered as blocking subsurface movement, may provide a face for ground-water to follow, under the added pressure head, into an adjoining waterway. Fault lines are the most important structural features. If they pass through or in close proximity to a dam site, a rigid masonry or concrete structure would be weakened or completely destroyed by any crustal movement along the line of weakness. If they pass through a reservoir site, they are lines of weakness along which ground-water might readily percolate, under head, into an adjoining water-shed.

May Damage Adjoining Lands

The impounding of surface water may result in raising the water level to heights detrimental to nearby lands. In such cases the principle of law involved generally results in an action for damages. In case the cause of the water level rise is disputed, the ground-water hydrologist may be called upon to investigate and report to the court the nature, extent, and results of the modification.

In the semi-arid regions of the western states, actions have frequently arisen from the impounding of surface water of streams which, in a natural state, would have supplied ground-water through seepage to lands favorably situated lower along the stream course. In such instances the values involved have been large and justified exhaustive investigation, not only of natural and modified ground-water conditions over the affected area, but of the natural and modified seepage due to the proposed or effected ponding of the surface water and the relations of the natural and resultant seepage to former and future ground-water conditions. The use of the impounded water, use of ground-water, and other elements enter into such problems, as the question is largely one of economics. It is the usual policy of the courts that water which would otherwise be wasted should be conserved and used for economic development, but the owner of a vested right in a portion of the water should not be deprived without compensation of such water as he can put to a beneficial use upon his land.

Wells Involve Problems

The effect of ground-water developments through wells has presented a variety of problems, both to the courts and those responsible for their projection. In the case of interference in the correlative rights between two wells or groups of wells drawing upon a common ground-water supply, but owned by different parties, it may be that the additional development complained of will increase the rate of discharge over the rate

(*Continued on Page 27*)

Four More Key Men Who Are Members of Editorial Board

These Construction and Equipment Leaders of Irrigation Industry Serve as Counsellors to MODERN IRRIGATION

ARTHUR BENT

SOME thirty leaders in various forms of irrigation activity have been introduced, from time to time during the past year, as members of the Board of Editorial Advisors of MODERN IRRIGATION. Representing agriculture, conservation, management, engineering, and other departments which go to make up the balanced and diversified industry comprehended by the general term "irrigation," these men constitute probably the most impressive group of leaders ever united in the support of a similar enterprise.

Two very important divisions of the Editorial Board, representing key departments of irrigation progress, are the groups made up of prominent men from the Construction and Equipment branches of the industry.

These two groups include eight members, well known wherever irrigation structures are built or irrigation equipment is used.

ARTHUR S. BENT

Arthur S. Bent, president of the Los Angeles Chamber of Commerce, vice-president of the Chamber of Commerce of the United States, and president of Bent Brothers, builders of some of the west's largest and most famous dams, is a man who has distinguished himself in a number of lines, but is probably best known for his eminence in work connected with the construction of large irrigation structures. Mr. Bent was born in 1863 in a tiny frontier settlement, on the Nevada-California boundary line, in Sierra County, California. When he was seven years old, he came with his parents to Los Angeles, and when a young man decided to become a construction contractor.

A short experience in the business, however, discovered to him that successful contractors must have the services of competent civil engineers at their command, and so, with characteristic decision, he underwent the training that made him an engineer—and one of real ability.

K. E. VAN KURAN

With the growth of the irrigation industry in the west Mr. Bent and his organization assumed a place of leadership in the building of great dams, the most recent of which to be erected by them is the great Exchequer Dam of the Merced Irrigation District. He has been active, also, in the work of various civic organizations, recently resigning after notable service as a member of the Board of Education of Los Angeles. He was elected president of the Los Angeles Chamber of Commerce, the largest and most active commercial body of its kind in the world, early in 1926, and was recently chosen a vice-president of the Chamber of Commerce of the United States. He has been president of the Associated General Conutractors of the United States, and has held membership and official positions in numerous other technical and professional organizations.

C. C. THOMAS

C. C. Thomas holds a high place in the fields of engineering design and construction both for his own wide experience and learning, and his connection with a firm which is, in a sense, both a national and an international institution, Dwight P. Robinson & Company, Inc.

He was born in Detroit in 1872, and educated at Leland Stanford University and Cornell University, receiving the degree of Mechanical Engineer from the latter institution. His early experience was gained as a draftsman with eastern concerns, in which he became successively assistant engineer and chief engineer.

From 1901 to 1903 he taught in New York University as professor of marine engineering and naval architecture; and during the succeeding seventeen years he held important professorial posts in various leading universities of the country, including: assistant professor of mechanical engineering, University of California; professor of marine engineering, Cornell University; professor of steam engineering, University of Wisconsin; professor of mechanical engineering, Johns Hopkins University.

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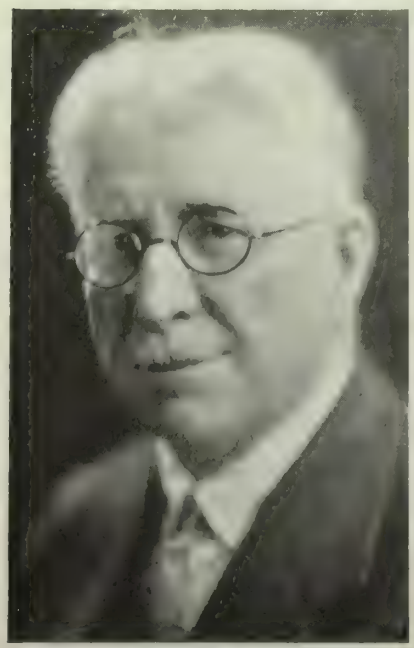

S. F. FORBES

The EDITORIAL

MODERN Irrigation

An Organized Voice for the Forces of Agriculture and Industry Which are Primarily Dependent upon Irrigation.

Published Once a Month
AT LOS ANGELES, CALIFORNIA, BY THE
PETROLEUM WORLD PUBLISHING CO. *Editorial and Executive Offices, 626 South Spring Street, Telephone Broadway 3262.* Branches: SAN FRANCISCO—447 SUTTER STREET, *Telephone Garfield 2772;* H. E. TAYLOR, *Manager.* CHICAGO—1163 MONADNOCK BLDG., *Telephone Wabash 8855;* JOSEPH E. O'CONNOR, *Manager.* NEW YORK,–56 W. 45TH STREET, ROOM 1105, *Telephone Vanderbilt 3672;* WERNER HAUPTLI, *Manager.*

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DOUGLAS G. MCPHEE
Executive Editor

By Annual Subscription in the United States and possessions, $2.00; Foreign, $2.50; Single copies on sale in the irrigation country, 20 cents. In ordering change of address, give both the old and the new address. Allow ten days for re-entries on the subscription list. Advertising rates and circulation data upon request. Checks should be made payable to Petroleum World Publishing Co.

Vol. II JUNE, 1926 No. 6

A Prophet of Success

THIS INDUSTRY of irrigation has its optimists and its pessimists, like every other division of mankind's activity. Neither one—possibly—sees always a true picture of water development; both are sincere, however, in their attempt to interpret the phenomena they see. In the midst of certain prophecies of doom, it is a relief and an encouragement to hear one strong and influential voice ever uplifted in the praise of what irrigation has accomplished, and confident predictions of its continued triumph.

J. Rupert Mason is one of those who feels strongly on the subject of the future of irrigation, and whose faith is not unsupported by good works. As head of the financial house of J. R. Mason & Company, he demonstrates his belief in a very tangible way, and by virtue of his comprehensive knowledge of irrigation matters, his words are attended with respect by the entire industry. This is what Mr. Mason has to say about the current outlook for irrigation:

"We are now witnessing one of the greatest movements toward irrigated agricultural lands ever known. The last year of subnormal rainfall once again reminded orchardists and farm owners of the South and West that irrigation is the most inexpensive and desirable crop insurance obtainable.

"I confidently predict that 1926 will prove the most active year we have ever witnessed, particularly in the great San Joaquin valley, Imperial and Palo Verde valleys of California, the Salt River valley of Arizona and the lower Rio Grande valley of Texas.

"This great activity will not alone be confined to the present increased demand for good land with dependable irrigation water, but will also be reflected through every ramification of the business and banking interests of the irrigated Southwest and West.

"The farmer, the city wage-earner, the banker, the merchant and the professional man—in fact every phase of human endeavor—is certain to feel the present forward trend, as it spreads over our fertile irrigated farms and orchards, where crop failures are unknown.

"Already hundreds of automomiles loaded with tourists, newcomers and their families from all points of the compass are arriving. Railroads also report tremendously increased travel through these sections. Countless millions of new dollars are now pouring into western banks from the sale of the enormous variety and quantity of fruit, vegetables and dairy products, made possible through irrigation.

"It is very significant that since the post-war depression, there have been almost no bank failures in any irrigated section.

"A personal visit to any of the valleys mentioned would disclose a story of well-being, independence and contentment attained in substantial, comfortable homes, amid pleasant surroundings and progressive neighbors.

"The financial stability of all irrigation districts in these valleys, under every test, not one of them having been delinquent for even one day in meeting any of their obligations, together with their present prosperity and steady growth, have set the one-crop and dry-farming sections agog with amazement, and far greater development and growth is confidently forecasted during the present year."

How's Business?

A FRIEND of ours, whose impressions of the irrigation industry are derived, very largely, through the sale of pumps and other equipment, told us the other day that his business had "slowed down considerably." Then he went on to elaborate his more or less pathetic tale of inactivity and sales resistance met in the field.

Yes, good friend, possibly present conditions in your particular branch of this great industry—the sale of pumps and kindred supplies—are not so good today as they were three months ago. Doubtless it is puzzling and discouraging to you, after bountiful rains and assurances of a "good year" had brought a general feeling of optimism, to find that your prospective customers are delaying their purchases and that sales records

POINT *Of* VIEW

Look the situation over from the farmers' standpoint, however, and you will get a different interpretation of the significance of today's slack demand. You will see, upon further analysis, that it is only an augury of better things for tomorrow.

The irrigation farmers of those sections where the 1926 rains have meant most, and were most needed, have been through a protracted period of water deficiency. They have learned, to their cost and sorrow, the need of making ample provision for a reliable and independent supply of water in times of natural shortage. That lesson will not soon be forgotten.

But at the same time that the farmers were learning these lessons, they were going through experiences and making financial sacrifices that would naturally prevent them from immediately putting into practice the salutary moral which the shortage brought home. In other words, Farmer Jones may have learned that he can not safely be without ample pumping equipment—but in the process he has not kept enough money to buy the equipment that he *knows he needs.* He is living today on the scanty returns, perhaps, of last year's crop. He sees evidences of a year of ample water supply, and is delaying the purchase of a pump until the need is greater and the pocket-book a little heavier.

So, good friend of the pump, don't be too much alarmed. The farmer who has come through the long dry period is not going to forget the need of the pump, if you do your duty in reminding him of it. He is only delaying his purchase.

Schools vs. Pumps

PERHAPS these farmer friends of yours are like the farmers living in a certain rural school district up in Ventura County in California—known as the "Briggs" district. For the past three years these prosperous farmers have been looking forward to having a new school. But each year they looked in vain for promises of plenty of water, and when the water came not, they were a little timid about making large expenditures for schools and similar luxuries.

And so they worried along for three years, each year planning the new building for the following season, and each following season deciding to retrench and wait conservatively until prospects looked a little better and a "dry year" appeared less imminent.

But this spring the rains fell, and on May 31 they had their exercises in the new school building, a beautiful, permanent structure that would grace any metropolis. This is the sort of thing that is happening all over the irrigation country—but perhaps these farmers are the very ones who are delaying their equipment purchases until later in the year. Perhaps the reluctance to buy pumps at this time means simply that they prefer schools and need them most—the pumps will come later.

And On the Other Hand

FROM OTHER sources there come reports of the most optimistic tenor regarding the business outlook in the irrigation field for the present and immediate future. One man, whose business is the sale of drilling rigs, says that things have never looked brighter, that the rains and higher water-table have stimulated irrigators to go down and get the water while it is there and that his equipment is meeting a steadily increasing demand. Several pump companies, whose business is not limited to California but is interstate and international in its extent, report larger sales, double shifts, expansion in factory space, and a margin of unfilled orders beyond capacity of production.

And, so, viewed from the standpoint of the industry as a whole there is little ground for a despondent view, and much reason for encouragement. In a few cases the lesson of the dry years was so expensive that equipment purchases must be longer deferred through necessity, but, in the main, the results will be a quickening of demand for the equipment that means insurance against unexpected drouth.

Politics vs. Policies

THE ACCUSATION has been made that partisan politics has begun to show its sinister influence in the matter of the Boulder Canyon Project Bill. When the House committee on irrigation and reclamation voted to delay consideration until after the congressional recess, there was apparent an alignment of influence along party lines. It was said that Representative Hayden feared to go back to his home state, Arizona, with the approval of the Boulder Canyon project as one of the last recorded achievements of his committee, for he must face an election there before Congress again convenes. Therefore he moved for delay, and he was supported without exception by his Democratic colleagues.

The whole course of the projected development of the Colorado River has been so hedged about by political considerations of one kind or another that it would seem that it might be spared the evil of party division, which will surely becloud the real issues involved.

The fact, however, remains that the problem of the Colorado River and its development is not a partisan issue. It is no more partisan than the river itself is Democratic or Republican. It is no more partisan than the great southwest is the exclusive charge of one party or the other. There are problems yet to be decided about the Boulder Canyon project; there are issues of fact and issues of policy, and these must be resolved; but there are no issues of politics, and the man who would surround the problem by questions of political expediency is creating fictitious obstacles that will embarrass an early and wise settlement.

Four Members of Advisory Board

(*Continued from Page 21*)

Since 1920 he has been western representative of Dwight P. Robinson & Company, Inc., with offices in Los Angeles. He is vice-president of the organization. He is a member of various technical societies, and author of a standard work of steam turbines.

A Leader in Electrical World

K. E. Van Kuran is a western product, born in Laramie, Wyoming in 1882, and brought up and educated in Oregon and Washington. His high school education was received in Portland and his higher training in the University of Washington at Seattle.

He entered college in 1900 with the purpose of becoming an electrical engineer, and gained valuable experience even as an undergraduate by working during vacations in the various electrical departments of the Seattle Electric Railway. He was graduated with the degree of Bachelor of Science in Electrical Engineering and a distinguished athletic record which included two years as captain of the crew.

Upon graduation, he immediately entered the Westinghouse Electric and Manufacturing Company as a college apprentice, and at the end of two years apprenticeship became a member of the headquarters sales department, occupying various sales engineering positions of responsibility.

In the fall of 1911 he came to the Los Angeles district office of his company as assistant district manager and was appointed district manager in 1915, which position he has occupied continuously since that date.

His usefulness as a citizen of Southern California is not limited to his service to his company, however, as he has held numerous positions of responsibility in various civic and professional organizations, including the Electric Club, the California Electric Bureau, Pacific Coast Electrical Association, and important committees of the Los Angeles Chamber of Commerce.

An Equipment Executive

S. F. Forbes occupies a unique position in the irrigation equipment field of the west. For the past nine years he has been Pacific Coast manager of Fairbanks, Morse & Company, a concern whose products have been synonymous with irrigation developments in this country for the last generation, in charge of all United States territory west of the Rockies, including Alaska, Hawaiian Islands and the west coast of Mexico.

It is perhaps not an overstatement to rect distributors of the company's own products or as jobbers for other manufacturers, fully fifty per cent are sold to the irrigation and its allied fields. Mr. Forbes has, therefore, had exceptional opportunity to visualize what irrigation, insay that, of all the varied lines carried by the Pacific Coast branches of Fairbanks, Morse & Company, either as di-

C. C. THOMAS

cluding water developments of every kind, means to the whole western half of the United States, as well as to the success and prosperity of the company with which he is associated.

His experience has differed radically from that of many members of the Board, having been predominantly a business experience, which has brought him into an understanding contact with the commercial and financial phases of irrigation as well as the many other industries served by his company in the world-wide field.

After a varied connection with large eastern corporations, as a young man, particularly in the business departments of some of the greatest railroads in the country, Mr. Forbes came to Fairbanks, Morse & Company twenty-one years ago, and has been, successively, purchasing agent, general manager of railroad sales, district sales manager in the eastern territory, manager of thee company's Los Angeles branch, and Pacific Coast manager.

As regional head of a company in such direct touch with agriculture and irrigation as that which he serves, and so largely dependent upon general conditions of prosperity, brought about by the intelligent application of water to the lands of the west, Mr. Forbes has a lively appreciation of the significance and problems of irrigation, and is one of its most earnest and influential leaders.

Work Approves Contracts for Owyhee Project

Drafts of contracts proposed to be entered into between the United States Government and three irrigation districts on the Owyhee reclamation project in Oregon were approved late in May the Interior Hubert Work.

The districts are the Owyhee Irrigation District and Slide Irrigation District, both in Oregon, and the Gem Irrigation District, Idaho. Under the forms of contract, all of which are similar in terms, each district agrees to pay its proportionate part of the construction cost of the project in 39 annual instalments, the first five instalments of which may be smaller than the remaining 34.

Execution of the contracts providing for the repayment of the entire construction costs of the project to the Government must be made with the various irrigation districts before actual construction is started by the Bureau of Reclamation. The Interior Department appropriation act for the fiscal year of 1927 makes available the unexpected balance of $315,000 of a previous appropriation to commence construction of this project. The total estimated cost of the Owyhee project when completed is $18,000,000.

Hits Brush Burning as Method of Increasing Run-Off

The fatuousness and fatal results of attempting to increase run-off of surface water by burning off brush cover was dealt with without gloves by George S. Hinckley, city engineer of Redlands, California, speaking at Riverside in May before the local chapter of the American Association of Engineers. Water conservation and storage were discussed by Mr. Hinckley, who pointed out the need of reforestation both from a local and national standpoint.

The speaker showed charts of burned-over areas in the west, and pointed out that it was easier to get money to fight forest fires than to prevent them, when the prevention is the more important thing. Comparing the utility of storage in reservoirs with underground storage in gravel beds, Mr. Hinckley asserted that the gravel bed method was not only cheaper but more efficient.

THE HYDRAULIC DIGEST

A Monthly Bulletin Board of Brief Facts and Events from Far and Near

Haugen Bill Defeated

The Haugen bill, providing for price stabilization by the government in the interest of the producer of farm crops, was defeated in the House of Representatives by a vote of 212 to 167 on May 21.

Water Election July 1

Voters of Morro water district, San Luis Obispo County, California, will go to the polls July 1 to ballot on the issuance of $35,000 in serial bonds to provide funds for the construction of a water system for the district.

Vale Project Gets Contract

A contract has been submitted to the Vale (Oregon) Irrigation District by the Interior Department, providing a basis for the continuance of operations, with a provision for repayment by project settlers over a period of forty years.

Discuss 10,000 Acre Project

Land owners of College City, Colusa County, California, are considering a project to bring water a distance of ten miles from the canal of the Glenn-Colusa Irrigation District to irrigate 10,000 acres in the neighborhood of College City.

Chelan District Approved

Organization of the Chelan River (Washington) Irrigation District has been approved by the county commissioners having jurisdiction. Four hundred acres are to be included in the district, and the cost of development is estimated at $40,000.

Vote to Accept Contract

Land owners of the Hermiston (Oregon) Irrigation District have voted to accept the contract offered by the federal government to govern the relations between the settlers and the Interior Department. The contract calls for the district to take over its own affairs on December 31, 1926, and to become responsible for its operation and maintenance.

Santa Ynez System Agitated

Residents of the Santa Ynez valley, Santa Barbara County, (Calif.) are once more interested in a project to create an irrigation district and build a series of dams in the valley. H. H. Henderson, an engineer, is the father of the idea.

Wants Mokelumne Water

Stockton, California, through its mayor, has made a move toward the creation of an adequate municipal water supply, in filing with the state Division of Water Rights application for permit to appropriate sixty second feet from the flow of the Mokelumne River, which would give the city a supply of 38,000,000 gallons daily.

Ask Receiver for Project

Application for a receiver has been filed in the Superior Court at Walla Walla, Washington, for Irrigation District No. 4, embracing the Burbank project, which has been in financial straits for some time past. The district includes 9,000 irrigable acres, and was organized in 1920. Reorganization may follow the appointment of a receiver.

Big Run-off in Lake Hodges

Lake Hodges, San Diego County, California, an important source of water for irrigation and domestic use to various parts of the county, has impounded a total of 10,500,000 gallons of water during the present season, according to figures of the San Diego city water department, which recently acquired the lake from the San Dieguito Water Company.

Senator Stanfield Beaten

Robert N. Stanfield, who has served as United States senator from Oregon since 1921, was defeated for the Republican nomination as a candidate to succeed himself in the elections held May 21. Frederick Steiwer, attorney and wheat grower of Pendleton, won over Senator Stanfield as the Republican nominee, and Bert E. Haney was the Democratic choice.

Vote $19,000 Bonds

Citizens of Ramona, San Diego County, California, on May 4 voted $19,000 in bonds for the establishment of a water district comprising 600 acres of land surrounding and including the town of Ramona. The water will be used for irrigation and to supply domestic needs as well, and will be drawn by pumps from the Santa Maria River. The vote was 98 to 2.

Will Survey Ochoco District

Oregon Agricultural College is to undertake an economic survey of the Ochoco (Oregon) Irrigation district, its extension department co-operating with the office of Rhea Luper, state engineer, it has been announced. The projected survey, which will be completed in July, it is anticipated, will constitute the first step toward a plan for solving some of the district's financial problems.

Offer Sale of Water Rights

The Stockton and Mokelumne Canal Company has offered to sell its canal system and water rights to the Woodbridge Irrigation District (California) for $250,000. The offer was made with the provision that it was for immediate acceptance, and that it should not cause delay to the pending application of the company for permission to abandon public utility service or to increase its water rates.

Palo Verde Growing

When sufficient irrigation water is available, 90,000 acres of land in the Palo Verde Valley, California, will be open for farming, it is declared by Myron M. Winslow, Riverside County farm advisor, after a survey of the valley's resources. Forty thousand acres, two thousand of which have been added in the past year, are now under cultivation. Cotton acreage amounts to 22,000 acres, alfalfa 7,000 acres, and vineyards 800 acres. The valley will depend on the Colorado River for further irrigation development.

HYDRAULIC ENGINEERING

Dealing with the Practical Problems of the Operating and the Consulting Engineer

MULTIPLE-DOME TYPE APPROVED FOR COOLIDGE DAM

FINAL steps toward commencement of construction of the Coolidge Dam on the San Carlos Indian irrigation project in Arizona were initiated May 10, when Secretary Work of the Interior Department approved a special report of the Board of Consulting Engineers recently appointed to pass on plans and specifications for this structure.

This board was composed of Major General William C. Langfitt and A. J. Wiley, consulting engineer, who have just completed an investigation of the dam site across the Gila River after which they prepared their report. With the adoption of the board's recommendations action is expected to be taken promptly in advertising for bids and awarding a contract.

In its special report the consulting engineers recommended approval of plans for the type of structure known as the "Multiple Dome Dam," estimated to cost $2,836,000. Except for minor modifications they also recommend that the plans for the dam as drawn up by the Assistant Chief Engineer of the Bureau of Indian Affairs and later approved by the Chief Engineer be definitely adopted.

Los Angeles Men Consultants

The plans for this dam were prepared in the Los Angeles office of the U. S. Indian Service under the direction of Major C. R. Olberg, Assistant Chief Engineer, Indian Irrigation Service. Louis C. Hill and Fred A. Noetzli, Consulting Engineers, Los Angeles, California, were appointed a year ago by the Commissioner of Indian Affairs to supervise plans and construction of the dam.

Designs were made for dams of the gravity type, arch, multiple arch, multiple dome and rock-fill type. In a report of last November to the Commissioner of Indian Affairs, the consulting engineers, Louis C. Hill and Fred A. Noetzli, recommended that bids be asked for the construction of dams of the gravity, multiple arch and multiple dome type, the final selection of the type of dam to be constructed to be made after receiving bids from contractors.

Recently, the Commissioner of Indian Affairs recommended to Congress the construction of the multiple-dome type of dam. The Secretary of the Interior appointed Major General W. C. Langfitt and A. J. Wiley to review the plans of the dome type and final approval by this board was given, followed by similar action by the Secretary on May 10.

Power Storage Feature

The report of the consulting board calls special attention to the fact that the construction of the dam and its use as a storage reservoir for irrigation will permit the generation of useful electrical power which will find an established market at profitable rates. It recommends that the necessary and mechanical appliances and machinery for this purpose be installed as part of the construction, also pointing out that the additional cost will not be great and the sale of power will relieve materially the operation and maintenance charges to the water users.

The construction of the project will make possible the irrigation of between 75,000 and 100,000 acres of land, about one-half of which will be lands of the Pima Indians, in the Gila River Indian Reservation, near Sacaton. The site of the dam is the Box Canyon of the Gila River, near the junction of the Gila and the San Carlos, about 50 miles above Florence.

The dam will create a reservoir the storage capacity of which will be approximately 1,200,000 acre-feet, and the annual average run-off at this point is approximately 400,000 acre-feet.

The height of the dam, from river-bed to the top of the structure, will be 220 feet, the height from river-bed to spill-way crest 200 feet, and the spillway gates will have a height of ten feet.

The plan to obtain a storage dam on the Gila river for the irrigation of lands in the Florence-Casa Grande valley was started in 1895 by Arthur P. Davis, when it became apparent that some method would have to be devised whereby the lands of the Pima Indians could be supplied with water to offset the inroads into their water supply from the river made by diversions in the upper river for the lands of white settlers.

Surveys were made during the ensuing few years at a number of possible sites on the river with the result that the Box Canyon near San Carlos was finally selected as the proper place for the location of the dam. By 1915, a large number of surveys of the river, possible water supply and other data, including the depth of bedrock at San Carlos, had been made by the reclamation service and the reports filed with the department of the interior.

The Southern Pacific railroad obtained a right-of-way through the canyon, but when the railroad company failed to begin construction within three years, A. C. Sieboth and J. M. Jamison filed for a dam site on the river at the Box Canyon. A fight was made by the railroad company to get the right-of-way renewed. A board of engineers was appointed to investigate and they found a better site about 1,000 yards upstream from the original site and recommended that the site be preserved by all means.

Diversion Dam Built

Under their recommendations, a diversion dam was built 14 miles above Florence and the canal system in the project laid out. A committee was then appointed to work with federal authorities in drafting a contract for the project and on May 1, 1919, the contract for the project was approved by the Secretary of the Interior and the project declared feasible, which settled the question as to the construction of the diversion dam. The following winter, February, 1920, the construction work on the Ashurst-Hayden diversion dam was started.

Having obtained the diversion dam, the residents of the Florence-Casa Grande valley then started a movement in August, 1920, for the construction of the dam at Casa Carlos.

A bill was introduced in congress by Senator Cameron calling for an appropriation for the dam, and early in 1924 the bill was passed in the senate. It was later passed by the house, and on July

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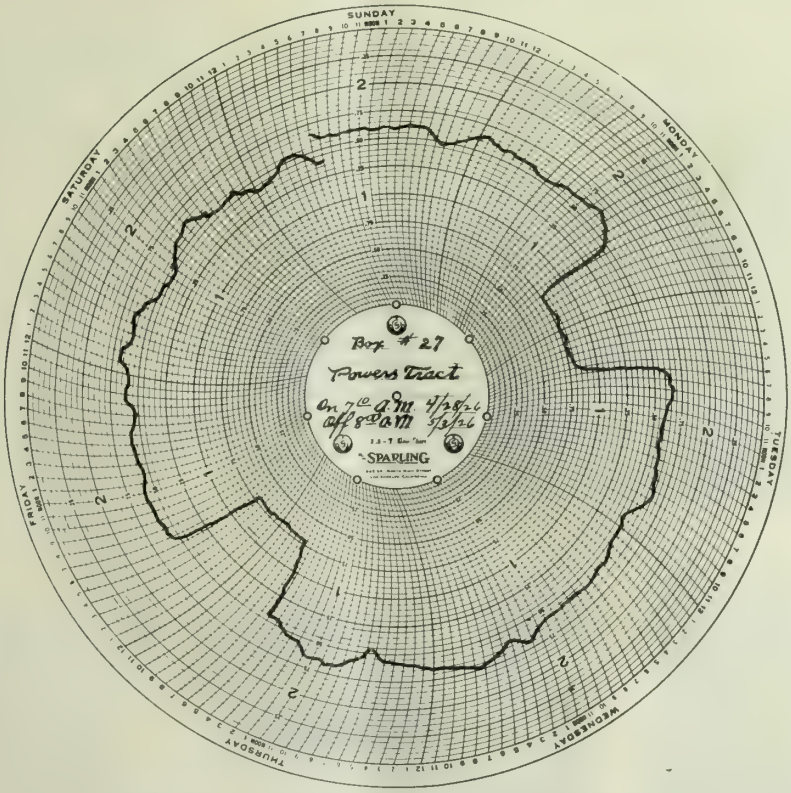

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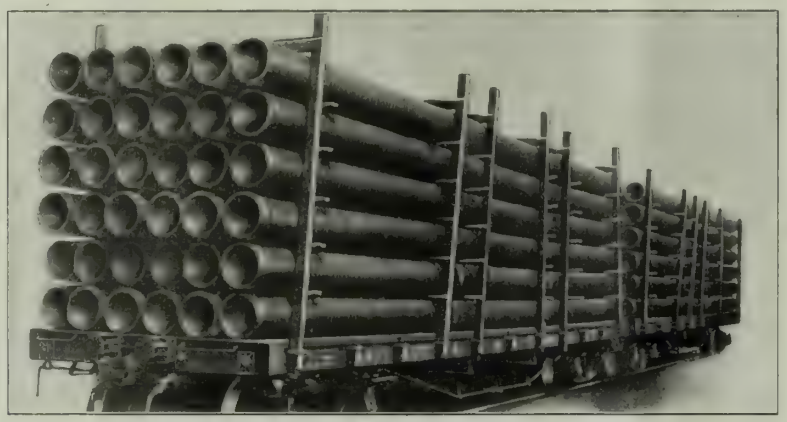

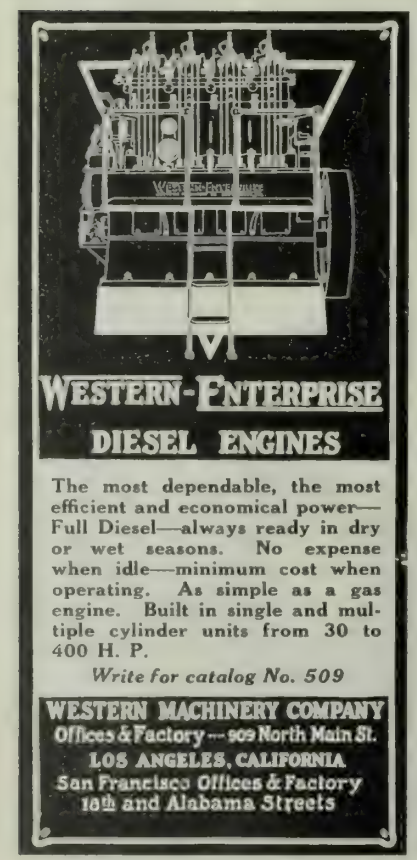

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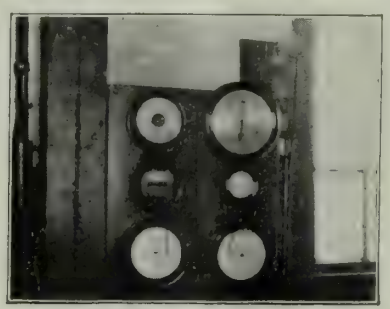

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7, 1924, President Coolidge signed it.

The bill authorized the appropriation of $5,500,000 for the construction of the dam, of which $450,000 was to be made available at once and the rest was to be appropriated as needed by congress. It is estimated that about five years will be required to build the dam and to complete the system.

Ground-Water Studies Should Pave Way for Developments

(*Continued from Page 20*)

of recharge so that a permanent depletion will be effected depriving the complaining over-lying land owners of an adequate ground-water supply. On the other hand, there may be a surplus of ground-water existing which may be taken if the projected development would not substantially burden the first takers. Interference, to intervening degrees, frequently results in the rights of each owner being determined in court, or, after investigation of the facts involved, amicably adjusted.

Artesian wells act similarly except that, in place of cone depression forming and the interference taking the form of a lowered water level, areas of lessened pressure result and interference is marked by a lessening of artesian discharge.

Complex Issues Presented

When the water-table is lowered through pumping operations over a wide area formerly the source of springs the flow of which was appropriated for use, or traversed by streams whose water had been all appropriated, the result is frequently a cessation of the spring flow or a decrease in the stream flow through induced seepage, and it may be made grounds for an action at court by the appropriators. The principal questions of fact involved are: first, whether or not the source of the ground-water is the appropriated water; second, the lateral extent of the area affected; and third, to what extent is the appropriator deprived of needful water through the operations of the ground-water user.

These questions would involve a study of the available supply for all purposes, and the portion of the supply necessary to satisfy the needs of the appropriators. Such an inquiry would result in the determination of whether or not a surplus of water exists from the supply over the needs of the appropriator, and the amount of spring flow intercepted or stream seepage induced by the pumping, which are the principal modifications resulting. This data would point to the answer to the question when and how such a taking deprives the appropriator of his rightful water, and the sugges-

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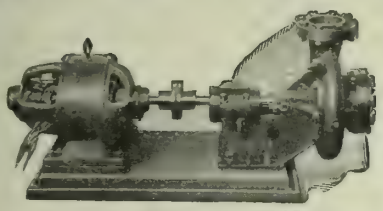

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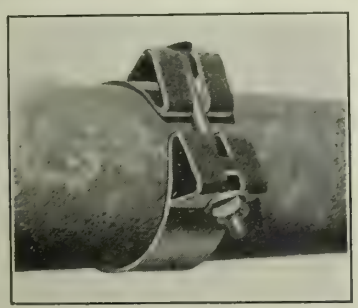

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tion of remedies through which the resources could be conserved and developed without injury to prior rights.

The construction of infiltration galleries and subsurface dams are similar in effect to both the ponding of surface water and the pumping of ground-water, in that they are designed to cut off the underflow from passing to lower lands and offer a new outlet for ground-water, thus creating an elongated cone of depression.

Common Fundamentals

In practically all problems presented to the ground-water hydrologist, the occurrence of the ground-water and its nature, source, extent, and direction of movement under normal conditions, must first be determined. Then the modification of these conditions due to human agencies are studied in relation to extent of effect, amount of effect, present result, and projected result of such modification. He must have a knowledge of geology and hydrology so that he will be able to make a collection of physical data in the form of geologic and topographic surveys together with well logs, and be able to prepare maps and profiles depicting the *geologic construction of the region* considered, and the relation of the topographic features to geologic and other conditions. He must make a collection of rainfall, run-off, and evaporation data, and translate it into charts or diagrams for ready understanding and analysis; and to present, in a manner readily understood, the relation of the *hydrographic data* to the occurrence of ground-water in the area.

The degree of refinement of method and detail of investigation justified by the problem depends largely upon the values involved and the purpose of the investigation. Investigations of the facts involved in disputed ground-water problems, the results of which may materially affect valuable water rights or set the money value of damages, justify exhaustive study, and one should not consent to appear in court as an expert advisor (or an advocate, as is usually the case, unfortunately) unless he has been given opportunity thoroughly to investigate and to prepare the solution of his problem. All this takes a special training and experience.

In conclusion it is believed by the writer that the trend of present development, with the magnitude and diversity of problems it presents, justifies the time spent in specialization in the study of the basic principles involved in ground-water hydrology, either while the engineer or geologist of the West or Southwest is obtaining the broad fundamental and important collegiate training of his profession, or immediately thereafter.

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MANAGEMENT

GETTING THE MOST OUT OF EVERY FURROW

By W. M. MERTZ*

GIVEN a definite stream of irrigation water every 30 days for example, what are the methods of orchard management which will conserve this to the greatest extent?

In the first place, irrigation water, to be of any value to the tree, must enter the soil. Since most of citrus feeding roots lie in the zone of earth from six inches from the surface to from 30 to 40 inches in depth, we are interested primarily in placing the largest possible percentage of the irrigation water between these two levels. The greater amount of surface soil we wet the greater loss from evaporation. If we soak the land to depths over four feet we have wasted not only water, but have washed out of our feeding zone valuable plant food. Too many furrows are wasteful of water since too much surface is wet only to be lost by evaporation. Too few furrows often mean an undue amount of waste water, and an inadequate portion of the root zone is wet, and very often too deep soaking results directly below the furrows, especially at the upper end.

It is thus very important to know the movement of one's irrigation water so that one can gauge his practices accordingly.

Extra Pipe-Line Saves Water

Most sandy or loamy soils with an average grade cannot be satisfactorily irrigated for a full ten acres length or 600 feet without wasting water at the upper end of the run by too deep soaking. Thus many of us would conserve much water for our trees by using an intermediate pipeline. Again by having this shortened distance to run the water, a lesser amount of time is necessary for the water to reach the lower end and this part of the orchard which usually receives too little water will improve from the added supply it receives.

Again with this middle pipeline it is not usually necessary to flush the furrows through by using large streams of water in them for a short time, repeating this procedure until all have been rushed through and then setting the water on the entire tract, a practice all too common on the lighter soils where the runs are long.

For a time this flushing system works reasonably satisfactorily, but usually results ultimately in the piling up of fine silt at the lower end of the grove which takes water more slowly than the rest of the orchard, drys out more slowly and is commonly puddled by working it too wet until a condition finally results which causes the relative amount of water absorbed at the lower end of the furrows to be very much less than throughout the major part of its length. This condition is so pronounced in many orchards today that even where middle pipelines have been put in and cross checking the lower ends adopted, the lower trees in the rows show marked signs of drought during most of the summer.

Shorter runs and running the water slower, or if possible, at a lessened grade, will avoid this condition and save much water for, under adverse condition such as I have just described, much water is lost by too deep soaking at the upper end if the lower end is to be wet up at all and usually an undue amount of waste water results in an attempt to hold a stream of water on this tightly compacted lower end of the orchard. With middle pipelines I have frequently found it necessary to run the lower half of the grove a longer interval than the upper; in extreme cases as much as eight hours on the upper end and 16 on the lower to get uniform penetration.

The Cultivation Question

Next comes the question of cultivation as it relates to irrigation efficiency. We have all been prone to consider that the work of irrigating our grove would almost entirely be lost if we did not establish a finely pulverized dust mulch just as quickly as we could get onto the land. The work of Prof. Veihmeyer and his associates occupied your attention in the morning session (Prof. Veihmeyer's paper appeared in the May issue of MODERN IRRIGATION) and I hope we have all disabused our minds of all our old ideas concerning the value of cultivation as a means of preventing losses of irrigation water by evaporation.

Nevertheless, cultivation is absolutely necessary as a means of preventing weed growth during the active growing season of our trees as well as the making possible the plowing of adequate furrows for subsequent irrigations. Some soils crack so upon drying that water penetration may be satisfactory when water is repeatedly run in the same furrow and on such types it is often a waste of time and money to cultivate after each irrigation unless weed growth is so rapid and the inter-

Summing It Up

Efficiency in irrigation depends primarily on the grower's intimate knowledge of his own soil. With this knowledge at hand he will find he is best able to use water efficiently if he can control the times when he takes the water and possibly the amount which he takes per run.

Lessened cultivation will markedly assist in bettering the penetration of water, especially at the lower ends of furrows.

Shortening the length of the furrows by middle pipelines will make for more even distribution and more efficient use of water.

The use of bulky organic manures and cover crops will not only aid the soil in taking water, but also increase its power of holding water against the pull of gravity.

Less flushing of the furrows by shortening them will reduce the packing and tightening of the soil near the lower ends of the furrows, thus tending to keep the orchard more uniform.

**This is the conclusion of Mr. Mertz' article in the May issue, in which he discussed the superiorities of the "Application System" to the schedule system for citrus irrigation. The article is reprinted from a paper delivered by the author to the Citrus Institute, and, while it was intended particularly for citrus growers, contains many valuable thoughts for other irrigators as well.*

vals between irrigations so long that undue weed competition is apt to result unless cultivation is resorted to after each run.

Certain it is that on some soils half the annual cultivation bill can be eliminated by cultivating thoroughly only after every other irrigation. In fact, on heavy clay soils having a tendency to crack, the furrows should be made several days in advance of the irrigation so that the bottom of the furrows may check and crack in order to get the most satisfactory penetration with the least surface soaking. On certain tight red clays which did not crack upon drying, a deep cultivation when the soil is rather dry seems to result in the best penetration of water, and on such types of soil it seems wise to do one deep working between each irrigation during the summer, since the furrow bottom tends to bake and usually takes water very slowly unless broken up.

Don't Work It Too Wet

The big thing with such a soil is not to work it too wet and also not to work it enough to reduce it to too fine a powder. This can be done by omitting all harrowing and waiting until the land will cultivate rather cloddy. A few workings of this sort and you will be surprised at the relative change in toughness of the clods which results from never powdering or working the land too wet.

On our sandy soils many of us do not have sufficient water to wet the centers between the trees both ways every run and the common practice of cultivating two or three ways when the water has been run only one is absolutely unnecessary and actually harmful in that puddling of the surface soil can just as surely be done by working and reworking dry soil as by working it too wet.

Where we have no trouble in getting ample penetration of our water cultivation should be limited to just as little as will permit of the keeping down of weeds and the remaking of new irrigation furrows. A soil worked only when rather dry and then only once will soon show improved receptions of water and less surface wet. Many a heavily cultivated grove will show a very wet surface after an irrigation with practically a dry subsoil when one lightly tilled will be soaked much deeper but show only the furrow banks wet.

Short Runs Profitable

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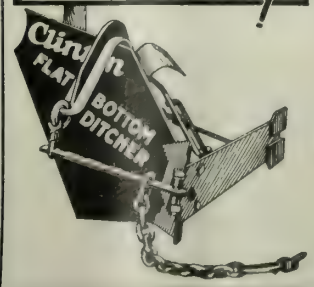

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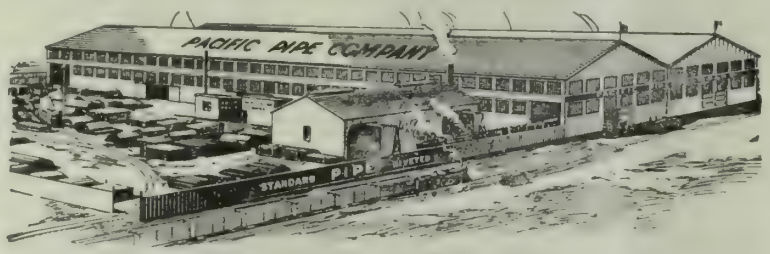

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Write for Information and Program

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the upper ends receiving the full 24 hours showed a penetration twice as deep as needed. By shortening the length of the runs by the middle pipelines and putting in more furrows much less water would be lost by too deep penetrations and also a much larger area of the root zone would be wet and made capable of feeding the tree.

One is paying taxes on the entire acre of land and if he is only keeping the roots in feeding condition on half that land he is certainly not getting maximum results from his acreage. Some may not have the water to do this but most of us could increase the percentage of actual feeding area by studying our water penetration and so proportioning our supply of water that a more uniform distribution was made of the water. During dry years any appreciable amount of waste water is unpardonable, and if we make a real study of our soil and its capacity to take water we should be able to prevent waste water and ultimately so distribute it that 75 per cent of our trees would show improvement either from added water where they were getting too little or lessened water when they were getting too much.

Organic Matter Helps

Organic matter incorporated in our soils such as manure, alfalfa, bean straws and cover crops will aid materially in getting the soil in proper shape to take and retain irrigation water and no system of orchard management is on a right basis without due consideration of these materials in relation to its scheme of fertilization.

The total rest from cultivation which the growth of a cover crop gives to the soil is often worth more than the actual organic matter which it adds. In addition the washing of the soil and packing often resulting from heavy beating winter rains is wholly prevented by a good cover crop. These crops grow when normally the tree is requiring a minimum of moisture and nature is supplementing our irrigations by rains. The early spring incorporation of this bulky green mass of leaves and stems puts the soil in an ideal shape to absorb and hold such spring showers or rains as are common, and puts us in fine shape for the irrigation season ahead of us. Often these rains absorbed into this friable mass of soil will so function as a damp blanket over the deeper subsoil previously wet by the winter rains or irrigations that once the cover crop is plowed down no further work or irrigation may be necessary for a couple of months.

For Detailed Listings, Branch Offices, Etc., See the Buyers' Guide to Leading Supply Sources—Pages 55-56

Electric Drilling Outfit Brings Big Economies

Savings in operating expense of more than 75 per cent over steam operation, together with a number of other advantages, resulted from a change-over from steam to electricity in drilling water wells in one instance in the Tulare Lake district of California. In this district the water question has always been a vital one. It was once necessary to build dykes to keep the water from flooding the land and it is necessary now to drill wells approximately 2,000 feet deep to find a source of supply.

Rotary rigs are used to drill the wells. Jake Smith, a local well drilling contractor, had been using steam as the power for his rigs but changed over to an electric oil well pumping outfit on one of the drilling rigs. With this outfit he now obtains speed variations from approximately 1200 r.p.m. down to 300 r.p.m. on the motor. The equipment, together with speed reduction gears, was mounted on two heavy timbers (12" by 12"), forming a sled which is easily moved with a tractor from one location to another.

Since adopting the electric outfit for drilling a large saving has been shown. With steam power it cost between $350 and $450 for fuel oil to put a well down 2,000 feet while the power bill for electric drilling has averaged approximately $90 per well.

With the steam outfit it took approximately two weeks to move and set up ready to drill, while, with the electric equipment, but three days are needed to move and set up ready to drill. Furthermore, the time of drilling has been reduced approximately 50 per cent with the electric rig. A further saving has resulted from the fact that one man less is needed on the crew of the electric rig.

Based on actual operations, Mr. Smith estimates that the electrical equipment has easily paid for itself out of the savings resulting from the drilling of three or four wells.

Report Imperial Crops

A crop report of the Imperial Valley, California, recently announced, shows that of a total of 605,000 acres on the American side of the international bounary, 369,633 acres represents the net area in crops. Of this total 289,132 acres are in field crops, with alfalfa leading (155,080 acres) and cotton second. Garden crops comprise 77,335 acres, 34,593 of which are in lettuce, and 30,774 in cantaloupes. Ten thousand acres are in permanent crops, such as orchards and vineyards.

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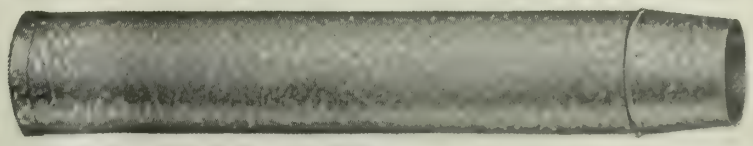

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WITH THE WATER COMPANIES

Of Interest Expressly to Water Works Engineers, Superintendents and General Managers

Irrigation Supplies May Be Used for Domestic Purposes—But Be Sure They are Pure!

By R. F. GOUDEY

Resident Engineer, Los Angeles Office, California State Board of Health.

THE IDEA of chlorinating irrigation supplies probably is new to most irrigation men; that is, if the present very poor sanitary showing of the majority of systems can be taken as a criterion. Not only have unforeseen conditions developed in the older supplies, completely changing the original character of the supply, but there is too great a tendency on the part of irrigation engineers even now to neglect sanitary features.

Volume is probably the first requisite of irrigation water. Moreover, wherever fresh water occurs or is made available, it should be used for irrigation at least so far as the southwest is concerned. The way it developed should include consideration of the public health aspect. Already neglect of this phase is crystalizing two very serious problems, which, if not corrected in time, will spread havoc not soon to be overcome. Chlorination in this connection will probably prove to be the greatest boon to irrigation.

Blame Western Crops

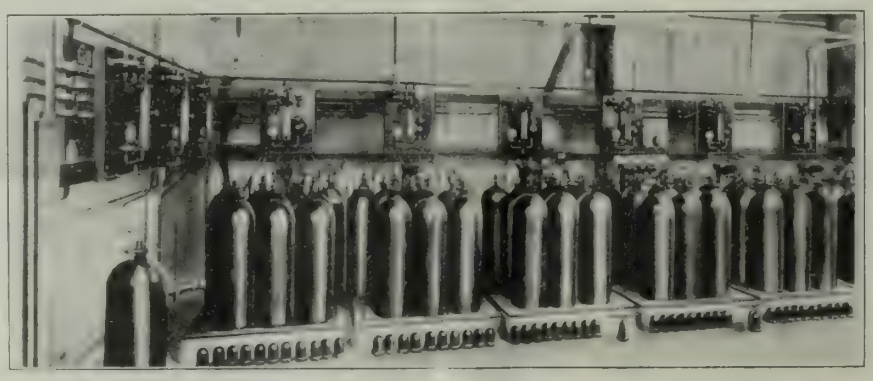
In the first place one of the most serious problems confronting irrigationists is the always threatening tendency of eastern health officers to blame eastern typhoid epidemics on western crops known to be irrigated with waters heavily polluted with sewage. Already large and valuable shipments have actually been quarantined. Many of the irrigation supplies are polluted with B. Coli or sewage characteristic microbes to the extent of one hundred per each cubic centimeter and are steadily getting worse. Either this contamination must be reduced at its source, the water treated, or restrictions made as to types of crops which can be grown with each individual water. Otherwise just enough quarantines will be made to jeopardize the entire industry. Chlorination is one of the first lines of defense from such attacks.

The second problem confronting irrigationists is the increasing number of typhoid fever cases in districts using polluted irrigation waters. Already several small epidemics have occurred. With ever-increasing pollution of most supplies this question becomes one of paramount importance.

Typhoid fever in the present enlightened age is inexcusable. The use of polluted irrigation water for drinking purposes or even waters subject to chance pollution is none other than criminal. While it is impractical to evaluate loss of time, suffering and disagreeable experiences of those suffering from the disease or to ever restore family ties of one dying from typhoid fever, courts have recognized, in a cold-blooded sort of way, that $1500 is little enough for medical care and loss of time to each patient and $10,000 to $25,000 as an average estimate for the value of a single death. Hence if but five cases, with one death each year, in any district, can be averted by proper treatment of water, it would warrant the expenditure of a minimum of $17,500 a year. Protection of irrigation supplies is not an academic or theoretical question. It cuts deep to the very heart of the industry and raises questions of economic necessities.

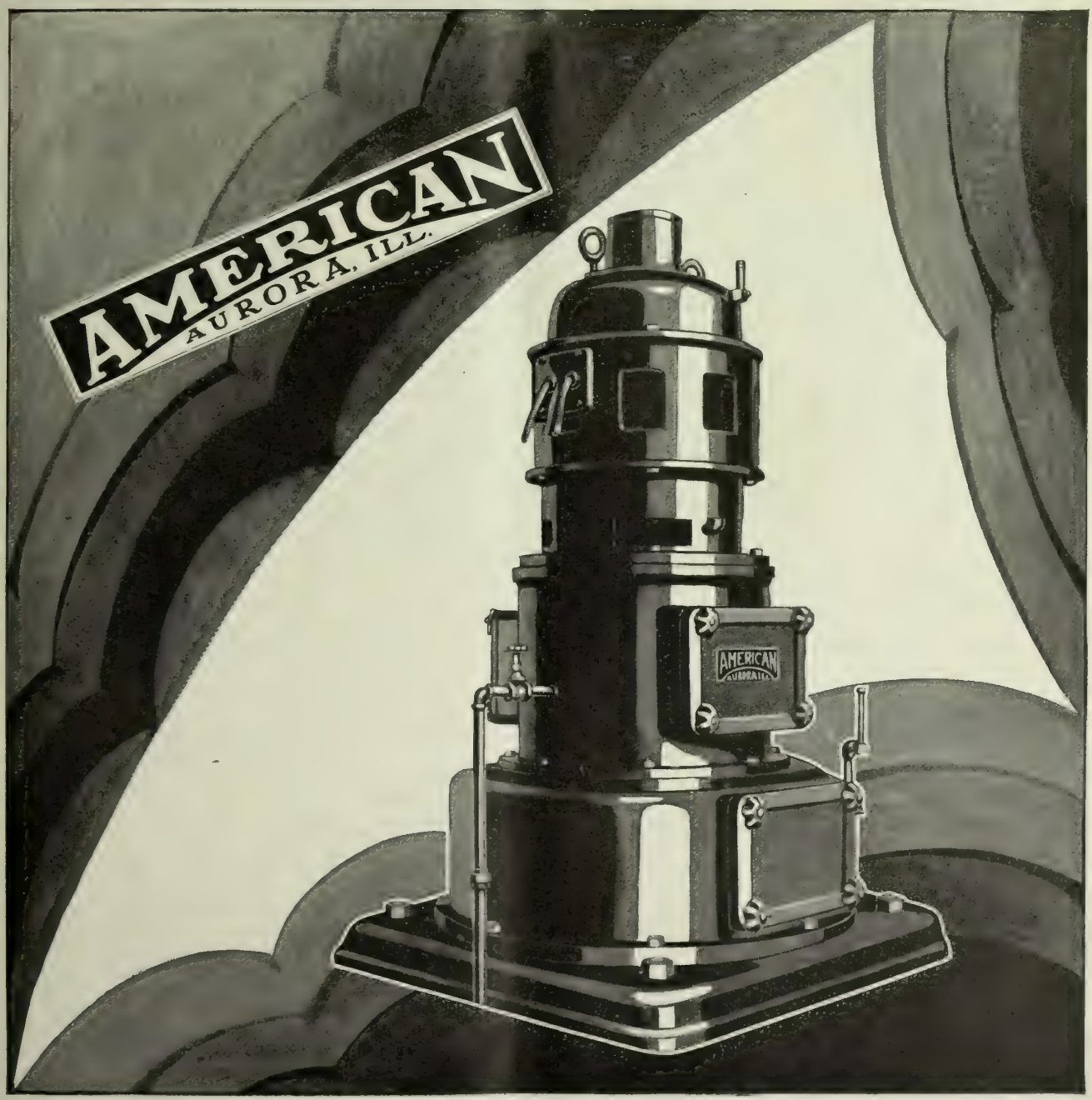
Should We Drink Irrigation Water

But the question is asked "Why let people use irrigation water for domestic purposes?" Some companies in order to protect themselves legally notify their customers not to drink the irrigation water, but with the full knowledge that their consumers have no other source at all for domestic purposes. Occasionally, a district is formed having a dual system to each farm, but this precaution is by no means common. Of late, many new supplies have been developed using the irrigaion supply for domestic purposes with the companies charging separately for domestic and irrigation water but with no thought of treating the supply or foreseeing any immediate unfavorable change possible to it. However much education is given to prevent using the irrigation supply for domestic purposes the fact remains that it is used and under a great variety of different circumstances.



Chlorination apparatus which treats every drop of water supplied to Greater New York. This is the Dunwoodie installation, which has been in continuous operation since 1916.

In a brief discussion such as this is, it is impossible of course to begin to touch upon all



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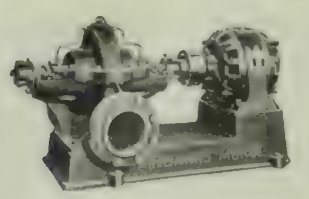

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of the different dangerous sources of pollution which are found in actual practice. The most common faults deal, first, with the water at its source, and second, with the types of construction used to convey it to consumers. Gross pollution results when domestic sewage is allowed to discharge in irrigation canals or streams. This practice is by no means rare, and in fact is far more prevalent than many irrigationists realize. The next most serious source of pollution is from summer mountain resorts and mountain cabin sites. Theoretically this danger should not exist. Inspections always reveal a large number of overflowing cesspools or cesspools located too close to streams. It can be safely said that none of the mountain resorts or cabins have permanent facilities for safe sewage disposal.

Then, too, the National Forest Reserve has invited the public to the nation's playgrounds, but with no provisions whatever for safe sewage disposal. With the advent of the automobile, more leisure time for the average person and the ever increasing number of mountain roads, literally place many thousands of campers on the headwaters of irrigation streams yearly. Sanitary facilities for these people, where not lacking entirely, are unreliable and inadequate.

A Recent Example

One of the most recent outrages has been the wholesale and deliberate stocking of reservoirs with fish and the migration of low type fishermen as well as duck hunters who remain in boats or along the shore line for many hours at a time, if not for an entire day, and with no sanitary conveniences at hand. Contamination of the supply under such circumstances is inevitable. A recent circularization of domestic water works in the United States shows that no fishing or hunting is ever allowed on supplies having no purification works. The novice at once calls attention to the enormous dilution in most reservoirs, declaring that to be sufficient safeguard. True it is that storage is a very important factor of safety, but it fails completely at low water stage, when the reservoir is rapidly filling and when winds are toward the outlet tower.

Another common fault in most supplies is failure to protect gravity pipe lines or flumes from storm water runoff. Very serious pollution may enter from such sources. Care should also be given to the design of gravity lines, flumes or canals to prevent storm runoff entering the supply where it would allow farmyard drainage or human excreta to be washed in. Failure to fence canals sometimes allows large animals to gain access. The use of canals for swimming should also be discouraged.

Chlorination is simply a means of reducing bacteria in a water supply without affecting any appreciable physical or chemical change. It is really the least that can be done and should not be confused with filtration, which is a more complete form of treatment to be used with difficult and highly polluted waters. The process is merely one by which liquid gas, contained in iron cylinders, is converted to a gas by the release of pressure, and after metering, added to the water supply. The machine for this purpose consists primarily of regulating valves, a compensating valve to give a constant flow of chlorine regardless of the varying tank pressure, an orifice type of meter for control and a diffuser to apply the chlorine gas to water. This equipment is compact and takes up very little floor space. There are different types of machines for varying installation conditions. Care, however, should be taken in properly locating the plant of a system so that all of the water is treated at the proper point.

The amount of chlorine required for disinfection varies from two to four pounds per million gallons. The more vegetable growth or mud the water contains the higher will be the required amount of chlorine to secure disinfection. The dose usually has to be adjusted to seasonal variations also.

The cost of chlorination is almost negligible. A good type of machine varies from $750 to $1,500. Liquid chlorine costs about fifteen cents a pound. Assuming that a supply of 2,000 inches or 78 acre-feet is to be chlorinated for nine months of the year with an average dose of three pounds of chlorine per million gallons, the cost of the best equipment including severe depreciation, interest and chemical, will be less than $3,000 a year. This cost would cover the expenses of two cases of typhoid fever but would be far less then the cost of a typhoid fever death. It is thus seen that this method of treatment is relatively cheap, affords good insurance to consumers and is a safeguard worth consideration.

Pertinent Questions

The first questions which arise are: "Will chlorine have any effect on soil?" "Will chlorine kill biological life or plants?" "Will it cause the water to taste?" When chlorine is added to water the greater part of it is immediately absorbed by the organic matter. Some of it is left for disinfection action. No free chlorine will be found in the water fifteen to twenty minutes after treatment. Chemical analyses will

(*Continued on Page 47*)

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RECLAMATION

RAILROADS AND RECLAMATION WORK TOGETHER

By HARDY W. CAMPBELL

RAILROADS and reclamation go hand-in-hand—both are pathfinders and empire builders; one seldom succeeds without the other.

It is unnecessary to say that the railroad is interested in irrigation. The railroad hopes to see every mile of its line producing something—not alone because it is dependent upon the tonnage it hauls, but because, naturally, the human element prefers to be surrounded by lands that are fruitful and green, supporting a clean, well-fed and contented populace. Such a condition is best for everyone and is the backbone of a nation. There are always families seeking new homes, therefore, the better agricultural results and conditions that a given section can obtain, the greater will be the tendency for such people to seek homes in that locality.

Benefits Not Expressed in Figures

Owing to the absence of records of a trustworthy character, it is practically impossible to state in figures from a tonnage standpoint what particular irrigation projects have accomplished, but it is manifest to all who will give any study to the question that many blades of grass have been made to grow on arid lands where no form of production appeared before; hence figures alone, even where available, fail to tell the story. The point is that these developed projects have produced new wealth for the individuals and the nation, and have provided a great source of new supply. Without them, we would not have the abundance of fruit and vegetables that now have become a necessity, but we would be going on as after the Civil War, when the daily menu was largely meat, wheats, potatoes and eggs. Fruits and vegetables, now so strongly advocated by our modern medical fraternity, were then delicacies beyond the reach of the ordinary person; today they are necessities, and to a large extent produced on irrigated lands.

California, probably of all of the western states, has attained the highest state of development through irrigation projects, and some idea of the results can be obtained from such figures as are available.

It is estimated that the irrigated area of California consists of approximately six million acres; this includes all land for which irrigation facilities have been provided and not abandoned—that is, lands which are irrigated annually or as needed, when water is available. Of this area some 2,753,095 acres are included in the active Wright Act irrigation districts, the Wright Act being a law passed by the California Legislature under which state aid is obtained under certain conditions. The balance of the area, or approximately 3,250,000 acres, represents lands that are served by mutual companies, commercial canal companies and individual private enterprises.

There is no segregation of data available that will show distribution or amount of production through irrigation enterprises as compared with other cultivated lands. The production figures are reported by crop varieties and for the state as a whole. However, that some idea may be obtained as to what has resulted, we may say that the beginning of irrigation on a large scale occurred in 1900, progress being slow until 1910; but from that period up until 1920, the extension of irrigation projects was rapid, particularly during the latter part of the period.

What California Produces

In 1909 the estimate of farm production of irrigable crops, such as orchard and vineyard varieties, was 2,108,307 tons, with a farm value of $48,718,000.00. In 1924, the records show a production of 3,020,000 tons valued at $178,000,000.00.

About as concrete an illustration of the value of irrigation as it is possible to offer, from a tonnage standpoint, is the Imperial Valley in California—not because other irrigated districts have not progressed, but because, situated as it is in the extreme southeastern corner of California, with the Colorado River on the east and the Mexican state of Lower California on the south, it represents an isolated territory and dependent upon irrigation for the production of any crop.

The irrigation project of this valley was started in 1900. The first water was brought into the valley in 1901. Picture, if you will, prior to that time the valley lying below sea level and nothing but a bleak uninhabited desert known as the "Colorado Desert." Starting from nothing in 1900, the population of the county in 1910, was 13,591; in 1920, the population was 42,383; in 1924, the estimated population was 65,000. It has within its boundaries several very fine towns, among which are Brawley, El Centro, Calexico and Imperial. They are all modern and will vie with the oldest communities for their paved streets, electric lights, good roads, schools, churches, hotels and all other good things that go to make up a healthful and thriving community. Intensive cultivation has followed and, while I will not burden you with figures, I am constrained to say that with an annual irrigation district tax of $5.00 per $100,000.00 valuation, the territory has grown, and where in 1910 there were but 78,252 acres under cultivation, there were 557,000 acres under cultivation in 1924. Where the production in 1910 was almost entirely alfalfa, barley and milo, with some cotton and livestock, the production in 1924 not only shows a healthy growth in the production of the articles mentioned, but includes grapefruit, asparagus, lettuce, grapes and almost every variety of fruits and vegetables, in addition to its livestock and grain development.

An Agricultural Prodigy

The early records of carload shipments are not available but in 1924 there were loaded and shipped from the valley 33,207 cars, principally cantaloupes, lettuce, watermelons and other commodities in proportion. According to the census of 1910, there was 9,650 head of dairy cattle in the county, and,

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according to the U. S. Department of Agriculture, there was 45,165 head in the county in 1923. It has become a wonderful feeding ground for beef cattle—more than 35,000 head of cattle were fed in the year 1923. The extent of this can be appreciated when I point out that the alfalfa production in 1910 was limited to 32,703 acres. In 1924, the acreage devoted to alfalfa was 151,000 acres; the average annual irrigation cost per acre for production of alfalfa amounts to $4.70. It is unnecessary for me to say what this means to the grower, but the growth of alfalfa and the feeding of stock has grown to be a most important industry and is carried along as a by-product, so to speak, of many of the land owners in connection with their production of fruits and vegetables and the dairy industry. In 1910 the assessed property value was $12,000,000.00; in 1924, it was slightly in excess of $51,000,000.00.

All sections of the country, of course, are not adapted to the production of citrus and tropical fruits; however, California, because of its pecularities, is going more and more to the growth of fruits and vegetables and this augurs well for Oregon and other western states, because in time it will mean a large demand upon these states from California centers of population. Even today California is a large importer of the hardier kinds of vegetables, such as potatoes and onions, as well as dairy products—butter, eggs and cheese, to say nothing of live stock, etc.

Cotton Is King

(*Continued from Page 12*)

ceded that the cotton industry apparently has passed the experimental stage in this Valley.

I have repeatedly heard the statement that it would be impossible for the cotton grower of the San Joaquin Valley to compete with the cotton grower of the southern States, but this is not true. Reduced fertility of soils planted for generation after generation to one crop, and the ravages of the boll weevil, have so reduced the yield per acre in the southern states that the cotton grower of the San Joaquin Valley is now in a position to compete on a cost basis with the southern cotton planter. The average yield per acre in the southern States is slightly less than one-third of a bale, while the yield per acre in the San Joaquin Valley has very nearly reached a bale per acre. This difference in yield makes cotton grown in the San Joaquin Valley cheaper per pound of lint produced than is the case in the South.

For Detailed Listings, Branch Offices, Etc., See the Buyers' Guide to Leading Supply Sources—Pages 55-56

Five years ago it was almost impossible to sell a bale of California cotton, even upon submitted samples, on account of the great variation of length and quality of staple, but today cotton buyers are scrambling for the San Joaquin Valley crop on account of the uniformity of quality and length of staple. The Valley, so far, has raised premium cotton, cotton that has commanded a premium of from one to seven cents in the open market.

This fact is partly the result of God-given climatic and soil conditions, and partly of the fact that our cotton has been raised under irrigation methods of growing with sufficient moisture at the proper time and no excess of rainfall that would tend to discolor and delay harvest. But although these are very important factors, they are not the most important. Success has been due, in great measure, to the fact that a few far-sighted men in this industry have fought for the idea of planting one variety only and have devoted considerable time to the production of pure seed.

Regardless of climatic or soil conditions, it would be absolutely impossible to raise premium cotton with mongrel seed. The Valley is also fortunate in the fact that, due to the interest of these same men, state legislation was secured, making of certain areas in the state of California, pure seed districts. But this legislation has not solved the problem of maintaining present production standards. This legislation has only made possible the maintenance of present high standards and it is still necessary to exercise every care to prevent contamination and ultimate deterioration of San Joaquin Valley cotton.

It is rather interesting to know that at the present time very little San Joaquin Valley cotton is actually consumed in the few mills on the Pacific Coast, as there are no mills on the Pacific Coast manufacturing high-grade fabrics for which this cotton is particularly adapted. As a result, California cotton is shipped to the eastern seaboard or to England, where it is manufactured into high-grade fabrics, which in turn are shipped to the Pacific Coast and the ultimate consumer in the West, literally speaking, pays the freight both ways.

Horse Mesa Concrete Poured

Pouring of concrete was begun late in May on the foundation of the Horse Mesa power dam of the Salt River Valley Water Users' Association, in Arizona, after two years of preparatory work. The dam is to be of monolithic type, 312 feet high from bed-rock. The cost of the dam together with electrical equipment, will be $4,800,000.

For Cleanout -- Maintenance -- New Ditches

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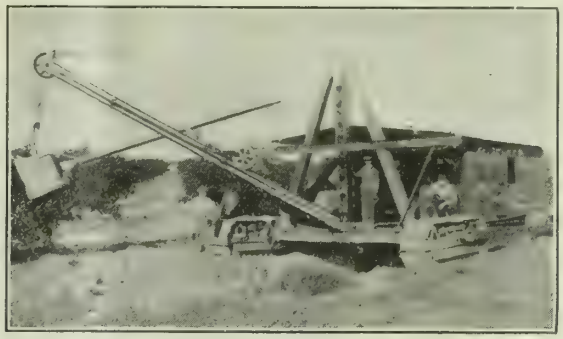
BAY CITY Land Dredges span the ditch, can dig any desired slope, and dump waste on both banks. BAY CITIES leave clean, wide berms, and can work up or down streams. One trip over the ditch is enough. The Shovel Type Dipper handles hard material in which other types of buckets cannot make a good showing.



At left—One yard BAY CITY Dredge digging and cleaning ditches in Florida Citrus Groves.

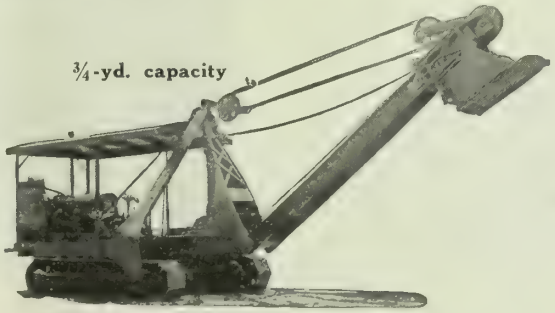
BAY CITY Land Dipper Dredges are built to fit the job. Walking, Crawler, Track or Floating mounting. Easily dismantled, transported and assembled. Capacities ½ to 1½ cubic yards. Oil engine or electric operation.

FOR SMALLER DITCHES — OR PIPE LINE TRENCHES

The BAY CITY 16-B convertible Excavator will handle a wide range of work. Operates Dragline, Trench Shovel, Clamshell or Skimmer. All steel. Shipped assembled. Digs any width or depth up to 20 feet.

STEEL CONSTRUCTION

¾-yd. capacity

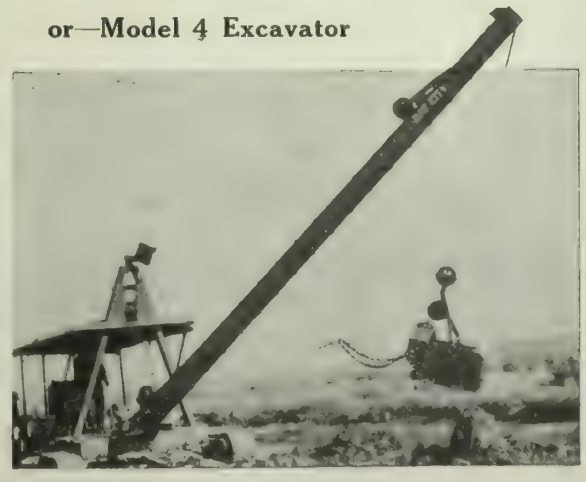


FULL CRAWLER MOUNTING

or—Model 4 Excavator

BAY CITY Model 4 is a small low-priced convertible, one-man operated Excavator. Fills the gap between hand labor and high priced equipment. Capacity 20 to 40 cubic yards per hour. Gasoline or electric power. A Real Digger economically designed for the small job. Also operates shovel, and clamshell.

WRITE FOR NEW CATALOG



One of the Model 4's Owned by Colorado Irrigation Companies. Cleaning Out Canal.

Our many years experience in manufacturing and operating Dredging machinery is at your service. Write us about your problem.

BAY CITY DREDGE WORKS

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San Francisco Representative:
J. P. Sherbesman, 560 Geary St.

Denver Representative:
H. W. Moore Equipment Co.

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WHO'S *WHO* AND WHO'S *WHERE*

IN THE WORLD OF HYDRAULICS

Personal Notes and Impersonal Observations About Men You Know

A. R. Olsen resigned as a member of the Board of Directors of the Harney Valley (Oregon) Irrigation District in May and was succeeded by Ivan Oakes, appointed by vote of the remaining members of the board.

Arthur E. Cowell, of Merced, California, has been reappointed to serve as city engineer for the city of Livingston. The appointment was said to have unusual significance, as it carries with it the responsibility of preparing plans and specifications for a new sewer and water system for the town.

Prof. Frank Adams, of the Division of Irrigation Investigations and Practice, University of California, has just returned from a hurried trip through central and southern California, during which he collected material for a new edition of his state bulletin on the irrigation district movement in California.

W. W. Houser, of La Feria, Texas, well known among the water users of that section, has been named a director and temporary president of the Lower Rio Grande Valley Water Users' Association, succeeding E. C. Snow, who resigned the presidency and directorship of the organization on account of ill-health.

L. R. Hoagland has been appointed as temporary receiver for the Attalia (Washington) Irrigation District No. 1. His first step, in accordance with the instructions of the court, will be to collect $800 for cleaning out the district's main ditch so that water may be delivered to project lands. Members of the Walla Walla Chamber of Commerce will provide the funds.

J. O. McElligatt, formerly of the San Francisco office of the Commercial Acetylene Supply Co., Inc., is moving to the Los Angeles headquarters of his organization to take charge of the sales department. E. S. Bishop, who has been taking care of the Los Angeles territory, handling both manufacturing and sales, will devote his entire time to the plant as engineer and superintendent in charge of manufacturing.

JAMES M. KYLE

James M. Kyle, former president of the Oregon Irrigation Congress, and an ardent advocate of the Columbia River Basin project, in the interest of which he has spent the past winter in Washington, D. C., has returned to Oregon, and in May was the honored guest at various centers of irrigation and reclamation activity. At Vale, Oregon, he was honored by a dinner, and at Baker was tendered a complimentary luncheon. He brought the most optimistic reports from Washington as to the probable future of the Oregon projects, including the Vale, Owyhee and Baker projects.

Fred A. Noetzli, Los Angeles consulting engineer, was in San Diego during May conferring with Fred Rhodes, city manager, on plans for the selection of a type of dam to be used by the city in the improvement of its water system. Mr. Noetzli was one of the consultants who recently recommended the multiple-dome type of dam for the Coolidge dam on the Gila River, and there is a possibility that this kind of structure may be adopted by San Diego for its future construction.

R. H. Ehlers was elected president of the board of directors of the Palo Verde Irrigation District, succeeding Aikman Armstrong, resigned, and A. T. Galloway was named vice-president to take Mr. Ehlers position, at the May meeting of the board.

Judge Marvin W. Conkling, of Imperial County, California, has announced his candidacy for re-election as judge of the Superior Court. He was formerly attorney for the Imperial Irrigation District, and in the disputes which have attended the affairs of that district has usually had a prominent part.

R. H. Thompson, well-known Seattle engineer, has been selected to make a comprehensive survey of the water needs of Bellingham, Washington, and to prepare plans for a water system for the city. He was selected for the commission by the members of Bellingham's wateer board after they had interviewed a large number of leading engineers of the northwest.

Pomona, California, after weeks of reports and investigations on the value of the water system of the Consolidated Water Company, has named, through Mayor S. H. Park, a committee of citizens to conduct negotiations with the company for the purchase of the system by the municipality. The committee includes: J. F. Lobingier, L. L. Lostutter, A. L. Hickson and C. S. Vanderdeck.

Paul Bailey, deputy state engineer of California, in May conducted an inspection tour of the Santa Ana River watershed, in Southern California, in company with the engineering advisory board representing the three interested counties. J. B. Lippincott, A. L. Sonderegger and George S. Hinckley, representing Orange, Riverside and San Bernardino Counties, comprise this board. Mr. Bailey reviewed, in the field, the findings of a state survey party that has been working on the tributaries of the Santa Ana River for several months.

Rio Grande Growth Brings New District Organization

The federal Department of Agriculture has announced that owing to the great increase during recent years in the agricultural development of the lower Rio Grande Valley, Texas, the Weather Bureau has decided to establish, effective June 1, 1926, a new river district for the Rio Grande below El Paso, with headquarters at Brownsville. Daily reports will be received from river stations between Eagle Pass and San Benito, Tex., and a daily river bulletin will be issued containing river and rainfall data, river and weather forecasts, and also flood warnings whenever necessary.

This service was urgently requested some time ago by the business interests of the lower Rio Grande Valley, but it was not until the present time that economies in other fields enabled the Weather Bureau to provide the additional service. It is expected that the new service will be of great value to the agricultural interests at all seasons of the year.

The new district formerly formed a portion of the district of San Antonio, and the Weather Bureau station at the latter place will still continue to exercise jurisdiction over the Colorado, San Antonio, Guadalupe, and Naches Rivers.

Concrete Pipe Tests July 10

Announcement is made, as MODERN IRRIGATION goes to press, of an event which will prove of interest to engineers, contractors, public officials and others dealing with concrete pipe, and concerned with its properties. Public hydro-static and crushing tests are to be conducted under the auspices of the California Associated Concrete Pipe Manufacturers at ten o'clock Saturday morning, July 10, at the Merritt Company pipe yards, 1700 S. First Street, San Jose, California. The tests will yield data on the value of concrete pipe for irrigation, sewers, storm drains and culverts.

Survey for Big Kern Project

Engineers of the Kern County Canal & Water Company are making extensive surveys which may lead to the construction of a dam below the junction of the north and south forks of the Kern River, it has been announced by the company. The project, as tentatively suggested, would include almost 2000 miles of irrigation canals, and an irrigated acreage of 150,000 miles, according to reports.

CLEARFLOW

INCLINED SEAT CHECK VALVES

BUTTERFLY VALVES

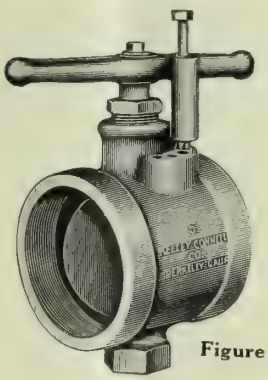

Figure 20

Butterfly Valves

Flanged and Screwed

Regular and Side-Outlet.

Bronze gates and moving parts.

Close-fitting and well-finished.

Elbow Check Valves

Silent
Reliable
Less head loss
More compact
Easier access to pump

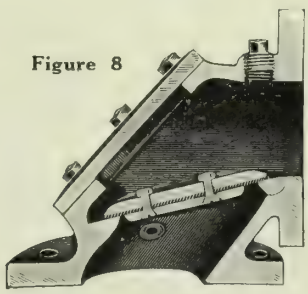

Figure 8

For sale by leading jobbers and dealers

WRITE FOR CATALOG "A" 1926

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Kelley-Connell Company

1330 Second Street **Berkeley, California**

DIGGING—CLEANING CANALS

AT LOW COST

THE NEW RUTH WITH ITS CONTINUOUS FLOW OF DIRT will dig or clean canals and trenches at a minimum cost per cubic yard or lineal foot heretofore considered impossible. The Ruth cuts continuous, even banks and smooth bottoms. Working successfully in marshy or dry ground, or canals full of water. The Ruth positively cleans the canal of all muck, sand, small willows, tules and water grasses.

Send for Bulletin No. 8—it illustrates the New Ruth Dredger; type and size of canals it will dig or clean; gives specifications, operating costs and maximum capacities.

RUTH DREDGER SALES CORPORATION

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LEGAL *and* JUDICIAL

A DEPARTMENT CONDUCTED BY HANKINS & HANKINS

Palo Verde District Organization Approved

Method of combining districts and of issuing bonds passed upon in California case.

The Palo Verde Irrigation District was organized under a special statute of the Legislature of the State of California, (Stats. 1923 p. 1067) for the purpose of taking over the properties and functions of three separate and independent agencies theretofore operating in the Palo Verde Valley and thereby eliminating the inefficiencies and extra expenses occasioned by the independent functioning of such agencies. The agencies so combined consisted of the Palo Verde Joint Levee District, the Palo Verde Drainage District and the Palo Verde Mutual Water System.

The method of organization was approved by the Supreme Court of California in the case of Barber v. Galloway, 195 Cal. 1.

In the case of Palo Verde Irrigation District v. Seeley, 71 Cal. Dec. 428 (Apr. 22, 1926) the method of issuing refunding bonds of the new district to redeem the bonds of the three agencies combined in the irrigation district was approved.

These cases are of importance in pointing out a way of combining various irrigation districts, reclamation districts and drainage districts in California where such districts are closely connected and could be operated more economically and efficiently as one organization.

Wells May Not Encroach Upon Ditches

Court holds that a land owner cannot sink a well so near an irrigation ditch as to diminish the flow of water in such ditch.

In the case of Lemm v. Rutherford, 49 Cal. App. Dec. page 368, (Feb. 5, 1926), the District Court of Appeal of California, third appellate district, held:

"The owners of a water ditch used by them for irrigating purposes, and extending in its course over the land of an adjoining owner over which they have an easement, are entitled to restrain such adjoining owner from pumping from a well erected by him on his said land immediately adjacent to said ditch the percolating and seepage waters from said ditch, and under such circumstances cases having to do with percolating waters, in the true sense of the word, have no application."

In distinguishing the cases concerning true percolating waters and citing the case of Katz v. Walkinshaw, 141 Cal. 116, the court states:

"The Walkinshaw case further holds that the law relating to percolating waters is very much limited and is governed largely by another rule, which is to the effect that one must so use his own property as not to injure that of another."

The appellants also urged in this case as was done in the Walkinshaw case, that the common law concerning percolating waters was applicable. On this point the court remarks: "the rule of the common law is not to be applied where the reason for it utterly fails . ."

Kansas Court Rules on Flood Damages

Holds action for damages to crops caused by obstructing a waterway is barred in two years.

In the case of Buss v. Missouri Pac. R. Co., 244 Pac. 1059 (April 10, 1926) the Supreme Court of Kansas held that the question of whether a channel was a natural water course is a matter to be submitted to a jury upon proper instructions from the Court as to what constitutes a "natural channel."

The Court further held that the cause of action for damages to the land itself arose when the obstruction was built but that the damages to crops arose when such damages occurred irrespective of the time the obstruction was placed in the channel and the statute of limitations of two years did not commence to run against such an action until the flood and damages occurred.

Ownership of Springs Expounded in Colorado

Court cites authority in discriminating between rights to water from spring flow.

The Supreme Court of Colorado in the case of Haver v. Matonock, 244 Pacific 914 (March 22, 1922) citing 1 Wiel on Water rights (3d Ed. 357) holds that, when a spring furnishes a stream of water that rises to the surface, the right of appropriation attaches, but, where the admitted quantity is so insignificant that a surface stream is impossible, when spread over the width of ground involved, the use of the water belongs to the person upon whose land it first arises.

Where Riparian Rights Conflict with Navigation

Supreme Court holds that power of Congress in relation to navigation takes precedence within necessary limits.

In the case of United States vs. River Rogue Improvement Co. 70 L. ed. (Adv. Vol 7, p. 148), Feb. 1, 1926, arising in Michigan, the United States Supreme Court considered the conflict between riparian rights of land owners and the right of Congress to control navigation.

The Court states: "The riparian rights of one owning land on a navigable river are of no avail against the exercise of the absolute power of Congress over the improvement of navigable rivers, but must suffer the consequences of the improvement of navigation, if Congress determines that its continuance is detrimental to the public interest in the navigation of the river."

However, the court does not hold that riparian rights cannot exist on a navigable stream and the right of Congress to control the stream is limited to the purposes of navigation. On this point the court says:

"It is well settled that in the absence of a controlling local law otherwise limiting the rights of a riparian owner upon a navigable river, he has, in addition to the rights common to the public, a property right incident to his ownership of the bank, of access from the front of his land to the navigable part of the stream, and when not forbidden by public law may construct landings, wharves or piers for this purpose."

This case is of interest, although it does not directly involve water rights, as no question of appropriation of water is involved. The right of Congress to control the navigable rivers of California and of the Western States will arise in the near future when irrigation will commence to conflict with navigation.

Rules Warrants Are Negotiable

Judge Everett Smith in the Superior Court at Yakima, Washington, has ruled that the warrant of an irrigation district is a negotiable instrument, in the case of William P. Harper & Son, Seattle bond firm, against the Pacific Power & Light Company. The power company received warrants from Irrigation District No. 4, Franklin County, in return for services, and endorsed the warrants to the bond house. When the district became insolvent, the holders of the warrants sued the power company.

Irrigation Under Tropic Skies

(*Continued from Page 17*)

lulu with Southern California oil. Although their water is costly this plantation produces the largest sugar tonnage per acre of any plantation in the islands, due to a highly perfected agricultural research department within its organization which has done much to eliminate wastage in the use of water. It might be helpful to reflect here that projects with cheap water are usually very poor producers due to careless and unscientific application of irrigation water, the results of which are drowned crops and water-logged lands. *The cost of the lack of control of cheap water is great.* The price is in the form of a drainage bill or a bankrupt farm.

These division weirs are typical of the distinctive type of irrigation construction being developed by American engineers in the Hawaiian Islands. They are found on the Hawaiian Commercial & Maui Agricultural Plantation.

The Ewa Plantation was the first to install irrigation meters to improve the control of their water distribution and to ascertain the amount of water required on their various fields to produce maximum crops of cane. The results obtained in 1924 in bringing about a more equitable water distribution among their several hundred irrigators independent of the duty of water data procured was so gratifying that a further quantity of meters was installed in 1925. By the end of 1925 the value of the metering system on Ewa Plantation had become so well known throughout the Islands that over 15 other plantations had ordered and installed meters. The largest installation, consisting of 200 meters, is on the Island of Kauai on American Factors properties. Here the major aim is to determine the duty of the various fields. In conjunction with most of the field duty determinations, submerged orifice meter measurements are being carried out on the various laterals and main canals to ascertain transportation losses.

Wasteful Methods Hit

Wherever meters have been installed, careless and wasteful methods of irrigation have disappeared. A Japanese irrigator who had been on one of the plantations for fifteen years approached the water overseer at one of the meters one

A TYPICAL LACY "JOB" IN THE IRRIGATION COUNTRY

Lacy Manufacturing Co.

Manufacturers of

Riveted Steel Pipe From 4 Inches to 10 Feet in Diameter

Originators *of Rust Proof Covering for Metal Pipe*

STEEL TANKS OF ANY CAPACITY

Works: Main and Date Sts. Los Angeles, Calif.

Main Offices: 601 Washington Bldg., Los Angeles

Roscoe Moss Company

Well Contractors

We are completely equipped to drill wells of any desired size or depth. Our rigs operate throughout the Southwest. Headquarters for well supplies; rental tools.

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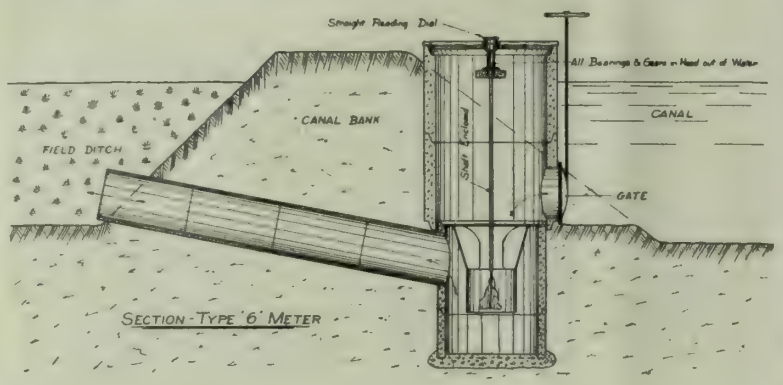
The RELIANCE METER



THE "Type 6" Reliance Irrigation Meter offers you standardized permanent construction at a very low first cost. Their sustained efficiency with a minimum of upkeep has been proven by 12 years usage. Cut shows installation of the 4 sec. ft. size in 24 and 30-inch concrete pipe. This is the standard type of setting adopted by many irrigation districts in Texas and elsewhere who are now equipping all their deliveries with this device. The "Type 6" meter is furnished in sizes ranging from ½ up to 16 sec. ft.

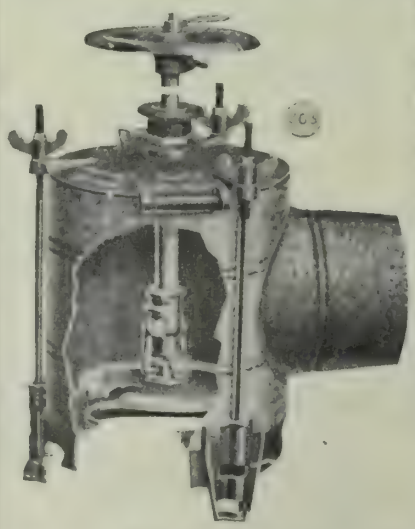
For further information and prices write—

RANDALL CONTROL & HYDROMETRIC CORP.
1014 E. Ninth St., Los Angeles, Calif.

Alfalfa Irrigation

MADE EASIER WITH

The Martin Portable Hydrant



Martin engineers, specialists in utility irrigation appliances, never designed a more serviceable piece of equipment than the MARTIN PORTABLE HYDRANT. Its use with MARTIN Alfalfa Valves Type B and Type Q enables the irrigator to control the direction of flow easily. Four checks can be irrigated handily and the operator knows exactly the amount of water each check is getting.

The spout of the hydrant can be turned in any direction. Two hydrants are generally used on one pipe line. While one is set and operating, the other can be moved to the next valve and set up ready to operate. Surface pipe can be attached to hydrant before valve is opened. The valve is opened and closed by the wrench built into the hydrant. After the entire field is irrigated, the hydrants can be removed and placed in the tool house. As the Type B valve is flat on top, there are no obstructions in the field to catch the mower or rake.

We manufacture the original line of Irrigation Appliances Outlet Valves, and Cut-off Gates for the definite division of water over the field from Concrete Pipe Lines.

WRITE FOR OUR LATEST CATALOG

MARTIN IRON WORKS

Dept. M, 1222 E. 28th St., Los Angeles, California

Box 757 Arcade Station Phone HUmbolt 3407

day and said: "Me no likee dis machine, because machine talk and head office know too very much about water." Human nature is similar the world over. When it recognizes that its conduct is going to get some publicity it becomes more conservative.

This same water overseer related another case where he had installed a measuring structure in a ditch where he had experienced a great deal of trouble in getting sufficient water down to irrigators at the lower end, due, he thought, to hoggish diversions by irrigators above. He installed the measuring structure but had no meter to place in it for several weeks. The meter box lid was padlocked, however, so the Japanese irrigators who soon discovered the orifice structure thought judgment was pursuing them and although there was actually no meter as yet in the structure the water shortage at the lower end of this lateral changed at once to a plentiful supply. This seemingly trivial situation had a vital bearing on economic crop production along this lateral. It is typical of conditions prevailing on many irrigation systems.

The irrigation of other crops is comparatively unimportant. Nevertheless, the rice fields planted mostly by the Orientals are a beautiful sight as you discover them lying here and there about the islands in little valleys, coves and low-lying areas where sufficient water is available to keep the fields flooded. The Hawaiian Islands would be only a beautiful spot on the earth were it not for the labor contribution of the Oriental and he would be a helpless factor without his rice.

The discussion of the pineapple industry does not come within the scope of this article but lest someone should wonder why the Islands' second greatest industry is left out of consideration it need only be mentioned that the pineapple is not irrigated. Nevertheless, it is worthy of mention because it fits in so well with the agricultural scheme of the Islands, making the higher non-irrigable lands useful for this industry.

Irrigation in Hawaii is the basis for practically all productivity and brings close to $80,000,000 or two-thirds of all its income annually to its population, supplying a means of livelihood to probably no less than 150,000 people and the sugar for millions of homes in America.

Urge $50,000 Bond Issue

Representatives of the Chamber of Commerce of Rialto, Calif., are urging a city election for a bond issue of $50,000 for the extension of water mains to outlying districts.

For Detailed Listings, Branch Offices, Etc., See the Buyers' Guide to Leading Supply Sources—Pages 55-56

You Can Use Irrigation Water for Domestic Purposes

(*Continued from Page 36*)

show that it has combined itself with other minerals in the form of chlorides. It does not have any effect whatever on the soil. The alkali content is increased less than one-half of one per cent. Since the chlorine is in the form of chlorides it will not have any disinfecting action on the soil. Water will not taste when chlorinated unless it contains certain types of microscopic growths which produce oils, which would taste any way. It would require a dose at least five times higher than recommended above, to cause taste in the water from chlorine alone. Aeration of irrigation supplies is highly desirable, but is not necessary in conjunction with chlorination.

Wherever chlorinators are installed the units should be in duplicate and a competent operator should be in charge to make simple daily tests to determine whether the treatment is effective, and a record of operation should be kept available for inspection.

Signal Hill to Ballot

Signal Hill (California) the oil city that grew out of Long Beach, and still depends on Long Beach water supplies, has moved to create an independent water system of its own. It is now planning for a bond election, to be held in July, at which a bond issue of $250,000 will be submitted to the voters.

Laguna Beach Starts Work

Work has been begun at Laguna Beach (California) on the construction of a $500,000 water system. A contract was recently let to Fisher & McCall of Santa Monica for laying 10,000 feet of 6-inch cast iron water main.

Newport Completes Reservoir

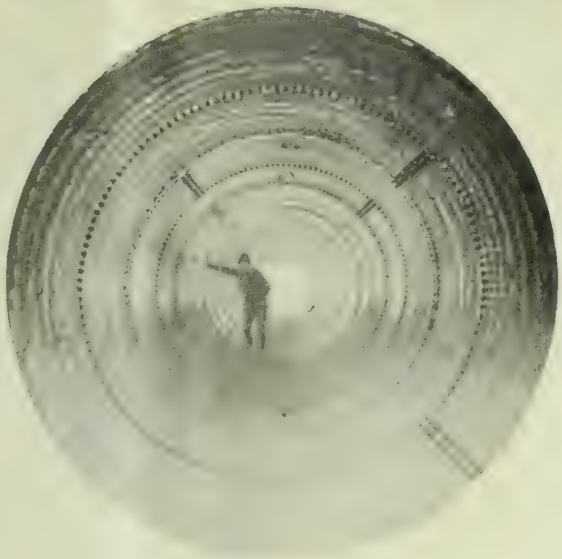
Newport Beach, California, has completed a new 3,000,000-gallon reinforced concrete reservoir, the first step in a $350,000 improvement program for the city's water system.

Lynwood Will Make Additions

City trustees of Lynwood, California, have approved plans for the addition of three-fourths of a mile of six-inch water mains to the municipal water system.

Increase Reservoir Height

Auburn, Washington, is adding a two-foot wall to the city's new rseervoir, thereby increasing its storage capacity by 1,000,000 gallons.



The Biturine Coating —inside and outside— of these 10 ft. penstocks is a guarantee of permanent protection.

Moccasin Creek Power House, Hetch Hetchy Water Project of the City of San Francisco.

The *RIGHT* Pipe Coating
for *ANY* Variety of Requirements

Biturine Pipe Dip—a hot application by the Dip Method.
Biturine Enamel—a hot application by Brushing.
Biturine Solution, No. 5—a cold application.

Biturine has proved its efficiency for PERMANENT Pipe Protection on many Engineering Protects for many years.

Our Handbook "Pipe Protection", with comprehensive Data and Specifications, will be a valuable addition to your latest information on this subject.

Write for your complimentary copy.

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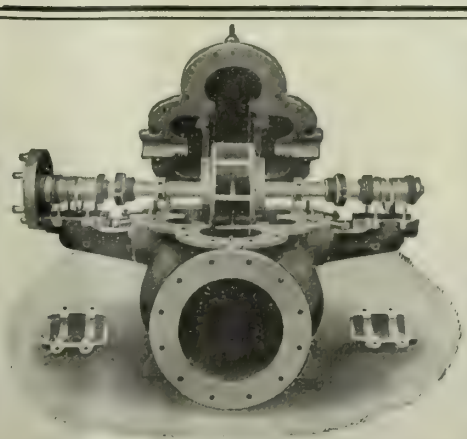

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We specialize in Centrifugal and Deep Well Turbine Pumps for Irrigation and Industrial Uses—
Our Double Suction Split Case Type illustrated herewith are carried in stock—
High in Efficiency.
Dependable in Performance.
And Low in Upkeep Costs.
Your inquiries are solicited.

G. W. Price Pump & Engine Co.
1350 Folsom St., San Francisco
Members Western Irrigation Equipment Assn.

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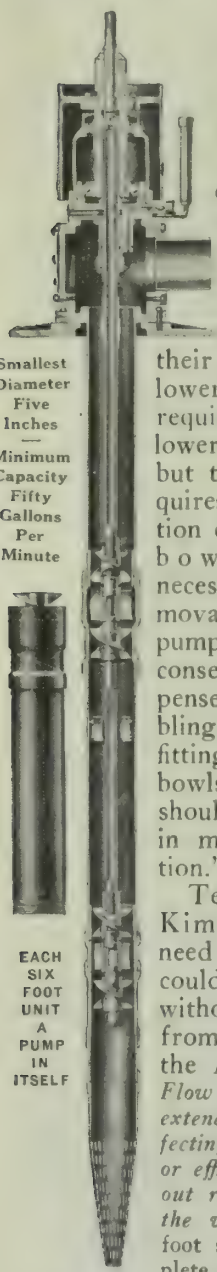
ITS NOT in the HEAD--- ITS IN THE PUMP!!!

U. S. Dept. of Agriculture says---



Smallest Diameter Five Inches — Minimum Capacity Fifty Gallons Per Minute

EACH SIX FOOT UNIT A PUMP IN ITSELF

Farmers' Bulletin No. 1404 on page 17, gives the following advice to purchasers of deep well pumps: "Manufacturers are likely to emphasize the ease with which their pump may be lowered to meet the requirements of a lowered water table, but this usually requires the installation of additional bowls or stages, necessitating the removal of the entire pump from the well, consequently the expense of reassembling the pump and fitting additional bowls or stages should be considered in making a selection."

Ten years ago Kimball saw the need of a pump that could be extended without removal from the well, and the *Kimball Direct Flow Turbine can be extended without affecting speed, capacity, or efficiency and without removing it from the well.* Every six-foot section is a complete pump.

Send Me Your Catalog No. 103.

Diameter of well.....inches
Depth of well.....feet
Distance to water.....feet
Draws down when pumping to.....feet
Lift above surface.....feet
Would like a capacity of.....gallons.

NAME.....

ADDRESS.....

FRANK J. KIMBALL CO.

1857 E. 15th St. Los Angeles, Calif.

Water Works Men Plan for October Convention

Directors of the California Section of the American Water Works Association met at Fresno in May to lay plans for the annual convention of the organization, which is to be held in San Diego during October. The directors at the same time received the Nicholas S. Hill cup, the trophy awarded last year to the California Section for its achievement in membership growth, the largest of any section of the association for the previous twelve-month.

Charles B. Jackson, president of the California section, received the trophy on behalf of his organization.

Courtesy San Joaquin Power.

A SOURCE OF JUSTIFIED PRIDE

Charles B. Jackson, president of the California Section of the American Water Works Association, expands his chest with pride as he receives the Nicholas S. Hill trophy awarded to the California section for the best membership record of any chapter in the organization.

Urges Probe of Water Problem

Representatives of ten communities of the San Francisco peninsula, acting through a committee recently appointed to initiate an investigation of the water problem of the entire district with its relation to possible solution through the Hetch Hetchy project, have made a report in which they urge a thoroughgoing survey designed to answer four principal questions.

The questions which the board deems necessary to investigate are:

1—When may we expect to obtain a water supply from Hetch Hetchy?

2—In the meantime, is a supply obtainable from the Spring Valley Water Company? And, if so, how?

3—Must the cities "go it alone" and seek individual sources of supply, and to what extent?

4—May all the peninsula cities join in an investigation that will answer the foregoing questions?

The committee's personnel includes Supervisors Shannon and Milo F. Kent of San Francisco, City Attorney John O'Toole, Professor C. D. Marx, president of the Board of Public Works of Palo Alto, and Oscar F. Weissgerber, city manager of San Mateo.

Salt River Valley President Sees Free Water in 1927

President F. A. Reid, making his annual report to the Salt River Valley Water Users Association in May, expressed confidence in the future of the organization, and, surveying the financial outlook, suggested that the water assessment for 1927 might be entirely eliminated by the sale of additional power. His report, in part, declared:

"The recent rains have guaranteed us a full water supply for this year. The apportionment has been increased to 3¼ acre feet delivered to each ranch. The careful use of water and the continuance of the operation of our pumps will guarantee us an excellent supply of water for next year also even if we should have a change back to drouth conditions next year. Such a contingency must be faced, and I would recall to you that in 1897, after five years of drouth, that spring rains produced as much water in the Salt River water shed as the recent storms and the following seven years were very dry ones. The pumps should be operated at full capacity until the reservoir fills except when the Verde river meets the irrigation demand. We have, therefore, fixed the budget at $3.96 per acre. This is $1.00 above the actual payment due the United States government for repayment of our debt and should be levied in order not to have the possibility of carrying over one year any shortage of revenue due to drouth conditions. If the reservoir fills before April 1, next year, we will be able to produce over $500,000 additional power during next year or the assessment can be cut to less than $2.00. I can assure you that if the reservoir does fill next year, in addition to reducing that assessment, the water assessment will be zero the following year."

After tracing the recent development of the association, Mr. Reid states: "Our irrigation system costs this year

with demand service will be but $2.00 per acre, less than any other large irrigation system with our long growing season, in the whole of America."

Touching upon the new project undertaken by the association, the Horse Mesa Dam, he reports:

The foundation of the Horse Mesa dam is now completely opened and ready for concrete. Concrete grouting of the rock has been in progress for the past two weeks and the concrete plant is ready for operation. A few more days will see concreting on a large scale. Our plant has a capacity of 1,000 cubic yards per day and with only 15,000 yards per month, which is our schedule will see the dam and power plant in operation in less than 10 months. There remains to be done to complete the Horse Mesa development, the following:

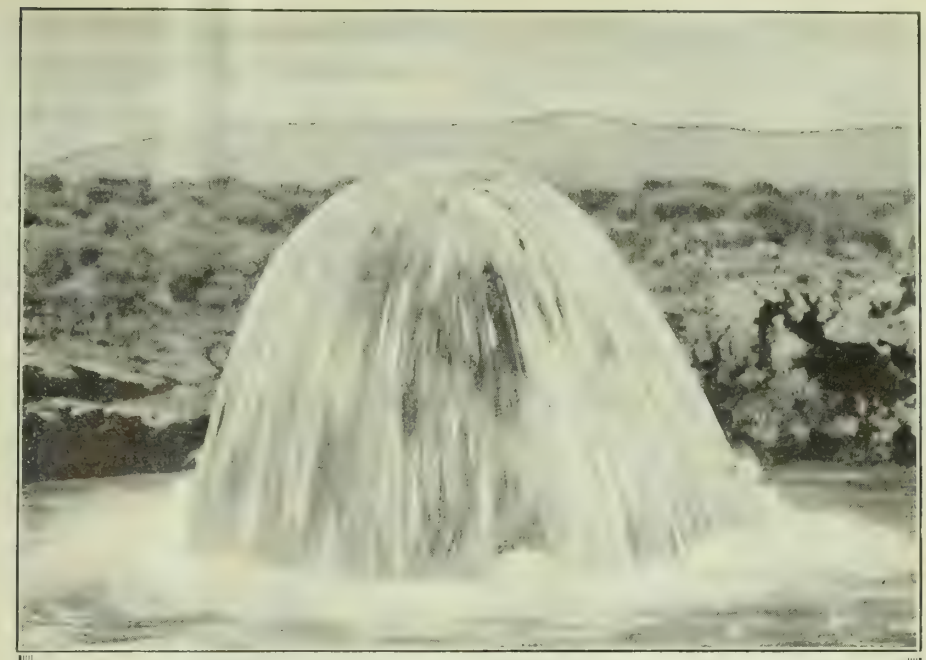
Excavation	$ 5,000.00
Grouting	20,000.00
River Control	10,000.00
Power House	100,000.00
Cement	420,000.00
Hauling and Handling Cement	140,000.00
Forms	110,000.00
Mixing and Placing Concrete aggregate	240,000.00
Completion of payments for Electrical Equipment and installing same	300,000.00
Completion of Transmission Lines	65,000.00
	$1,410,000.00
Interest on Bonds	140,000.00
Engineering and Contingencies	100,000.00
	$1,650,000.00

Planes Patrol Forest Areas of Pacific Coast States

Airplane patrol of the forested regions of Pacific Coast states by the U. S. Forest Service started June 2. Planes are operating out of Mather Field, Sacramento, and Griffith Park, Glendale, and on June 16, forest airplane patrol will start in Oregon, Washington, western Montana and northern Idaho.

Airplane forest patrol was again made possible this year by a special appropriation of $50,000 by Congress. Planes will be supplied by the U. S. Pilots and mechanics have been selected from specially qualified officers and enlisted men of the Air Service reserve corps.

Airplanes will be used this year, primarily for the reconnaissance of burning fires, for patrol duty following lightning storms, and for the transportation of emergency equipment to the fire line. Patrol service will be rendered, on request, to state officials and other agencies cooperating in fire prevention in the Pacific Coast forest regions.



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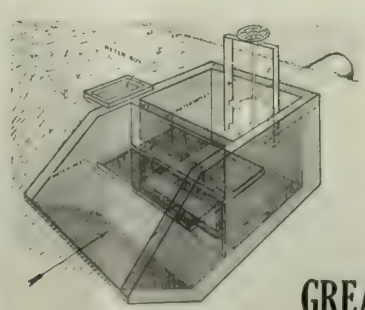

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SURVEY *of* HYDRAULIC DEVELOPMENT

As Shown by Official Records of the Month -- Local, State, and Governmental

Permits Issued

Among the more important permits to appropriate water issued by the Department of Public Works, Division of Water Rights of California, during the month of May, 1926, were the following:

Permit No. 2479, Application No. 4837 (Los Angeles County) Isuued to John Snyder, Llano, Calif., May 11, 1926, for 0.004 cubic feet per second from Two Unnamed Springs in Section 24, T 4 N, R 8 W, S.B.M. for irrigation, stock and domestic purposes on 47 acres in said Section 24. Estimated cost $2000.00.

Permit No. 2480, Applicaion No. 4865 (Shasta County) Issued to Jay Boright, Buckeye, Calif., May 11, 1926, for 0.5 cubic foot per second and 5 acre feet per annum, from Grape Vine Springs in Section 10, T 32 N, R 5 W, for domestic and irrigation purposes on 26 acres in Section 11, T 32 N, R 5 W, M.D.B. & M. Estimated cost $1200.00.

Permit No. 2481, Application No. 4866 (San Luis Obispo County) Issued to Thomas W. Arnold and Charles T. Sorenson, Los Angeles, Calif., May 11, 1926, for 0.12 cubic foot per second and 18.5 acre feet per annum from Pozo Creek in Section 20, T 30 S, R 15 E, M.D.M., for irrigation purposes on 123 acres in Section 20 and 45 acres in Section 21, T 30 S, R 15 E, M.D. B. & M. Estimated cost $5000.00.

Permit No. 2485, Application No. 4922 (San Joaquin County) Issued to D. Muller, Stockton, Calif., May 13, 1926, for 2.15 cubic feet per second from San Joaquin River in Section 21, T 1 N, R 6 E, M.D.B. & M., for irrigation purposes on 172.1 acres in said Section 21. Estimated cost $2500.00.

Permit No. 2486, Application No. 4921 (San Joaquin County) Issued to M. Bronich, Tracy, Calif., May 13, 1926, for 2.99 cubic feet per second from Old River in Section 33, T 1 S, R 5 E, for irrigation purposes on 239.8 acres in Sections 26, 29, 32 and 33, T 1 S, R 5 E, M.D.B. & M. Estimated cost $2000.00.

Permit No. 2487, Application No. 4894 (San Joaquin County) Issued to Matie S. Vail, Stockton, Calif., May 13, 1926, for 8.1 cubic feet per second from Beaver Slough in Section 8, T 4 N, R 5 E, for agricultural purposes on 277.3 acres in Section 5; 373.0 acres in Section 8 and 0.6 acres in Section 17, all in T 4 N, R 5 E, M.D.B. & M. Estimated cost $32,500.00.

Permit No. 2488, Application No. 2217 (San Bernardino County) Issued to Water Conservation Association, Riverside, Calif., May 13, 1926, for 48,000 acre feet per annum from Santa Ana River in Section 9, T 1 S, R 2 W, S.B.B. & M., for irrigation and domestic purposes on 52,640 acres in T 1 S, R 3 and 4 W, T 2 S, R 4, 5 and 6 W, T 3 S, R 5, 6, 9 and 10 W, T 4 S, R 9 and 10 W, and T 5 S, R 9 and 10 W, S.B.B. & M. Estimated cost $1979.62.

Permit No. 2489, Application No. 4123 (Yolo County) Issued to S. Sweet Co., Visalia, Calif., May 13, 1926, for 23.0 cubic feet per second from Borrow Pit of Reclamation District No. 999, in Section 21, T 6 N, R 3 E, M.D.M., for irrigation purposes on 3698 acres in Sections 16, 17, 18, 19, 20, 29, 30 and 31, T 6 N, R 3 E, M.D.B. & M. Estimated cost $30,000.00.

Permit No. 2490, Application No. 4124 (Yolo County) Issued to S. Sweet Co., Visalia, Calif., May 13, 1926, for 7.12 cubic feet per second from Borrow Pit of Reclamation Distric No. 999 in Section 21, T 6 N, R 3 E, M.D.M., for irrigation purposes on 620 acres in Sections 20, 21 and 29, T 6 N, R 3 E, M.D.B. & M.

Permit No. 2491, Application No. 4698 (Santa Clara County) Issued to Montezuma Mountain Ranch School, Los Gatos, Calif., May 17, 1926, for 0.25 cubic foot per second from September 1st to June 1st and 0.10 cubic foot per second from June 1st to September 1st from Collins Creek in Section 7, T 9 S, R 1 W, M.D.B. & M. for domestic and irrigation purposes on 15 acres in Section 6, T 9 S, R 1 W, M.D.B. & M. Estimated cost $12,000.00.

Permit No. 2492, Application No. 2778 (Butte County) Issued to Oroville-Wyandotte Irrigation District, Oroville, Calif., May 17, 1926, for 50 cubic feet per second and 25,000 acre feet per annum from Lost Creek in (1) Section 20, T 20 N, R 8 E, M.D.B. & M., (2) Section 24, T 20 N, R 7 E, M.D.B. & M., for irrigation purposes on 31,463 acres within the boundaries of the District. Estimated cost $820,500.00.

Permit No. 2493, Application No. 1918 (Fresno County) Issued to San Joaquin Light & Power Company, Fresno, Calif., May 17, 1926, for 450 cubic feet per second from North Fork Kings River, North Fork Rancheria, Rancheria and Statum Creeks in Sections 6, 17 and 20, T 11 S, R 28 E, for power purposes in Section 6. 7102 T.H.P. to be developed. Estimated cost $3,500,000.00.

Permit No. 2494, Application No. 2024 (Fresno County) Issued to San Joaquin Light and Power Corporation, Fresno, Calif., May 17, 1926, for 125 cubic feet per second from Helms Creek in Section 7, T 10 S, R 28 E, for power purposes in Section 30. 23,011 T.H.P. to be developed. Estimated cost $2,500,000.00.

Permit No. 2495, Application No. 4703 (Fresno County) Issued to San Joaquin Light and Power Corporation, Fresno, Calif., May 17, 1926, for 220 cubic feet per second from North Fork of Kings River in Section 6, T 11 S, R 28 E, Section 1, T 11 S, R 27 E, Section 3, T 12 S, R 27 E, Sections 10 and 12, T 12 S, R 26 E, for power purposes in Wishon, Haas, Balch, Junction and Kings River Power houses. 141,750 T.H.P. to be developed. Estimated cost $32,300,000.00.

Permit No. 2496, Application No. 4704 (Fresno County) Issued to San Joaquin Light and Power Corporation, Fresno, Calif., May 17, 1926, for 330 cubic feet per second from Upper North Fork, Fleming Creek, Post Corral Creek and Helms Creek in Section 7, T 10 S, R 29 E, Sections 1 and 7, T 10 S, R 28 E, Section 26, T 9 S, R 28 E, for power purposes in Section 30, T 10 S, R 28 E. 60,750 T.H.P. to be developed. Estimated cost $10,000,000.00.

Permit No. 2498, Application No. 4743 (Sacramento County) Issued to Carmichael Irrigation District, Sacramento, Calif., May 21, 1926, for 10 cubic feet per second from American River in Section 22, T 9 N, R 6 E, for domestic purposes and irrigation of 3100 acres within said District. Estimated cost $120,000.

Permit No. 2500, Application No. 4849 (Mendocino County) Issued to E. L. Cunningham, Ukiah, Calif., May 21, 1926, for 1.65 cubic feet per second from East Fork of Russian River, in Section 22, T 16 N, R 12 W, for domestic and stock watering and irrigation of 132 acres in Section 22.

Permit No. 2501, Application No. 4856 (Butte County) Issued to P. N. Ashley, Biggs, Calif., May 22, 1926, for 8.91 cubic feet per second from Main Drainage Canal Drainage District No. 100 in Section 15, T 18 N, R 1 E, for irrigation of 356.5 acres of rice in Sections 15 and 16. Estimated cost $1150.00.

Permit No. 2505, Application No. 2774 (Amador County) Issued to Preston School of Industry, Waterman, Calif., May 26, 1926, for 8.3 cubic feet per second and 3750 acre feet per annum from Sutter Creek in Section 1, T 6 N, R 10 E, for domestic and irrigation of 663.93 acres near point of diversion. Estimated cost $75,000.00.

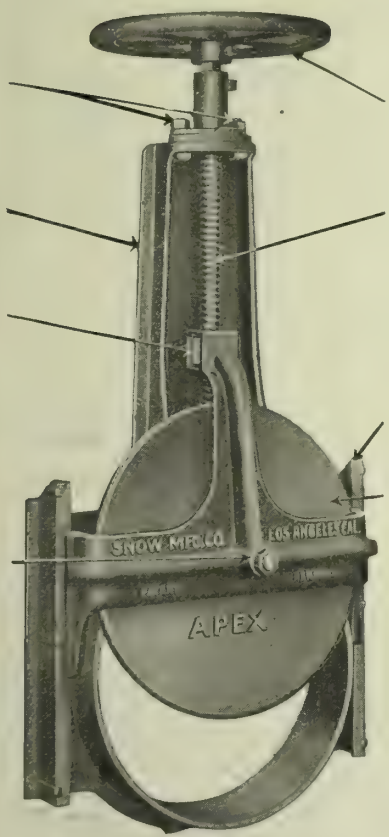
Permit No. 2506, Application No. 2775 (Amador County) Issued to Preston School of Industry, Waterman, Calif., May 26, 1926, for 10 cubic feet per second and 3750 acre feet per annum from Sutter Creek in Section 1, T 6 N, R 10 E, for power purposes in Section 24, T 6 N, R 9 E. 309 T.H. P. to be developed.

Permit No. 2507, Application No. 4388 (Sacramento County) Issued to Wm. J. Sheldon, Slough House, Calif., May 26, 1926, for 2.5 cubic feet per second from Cosumnes River in Section 3, T 7 N, R 7 E, for domestic and irrigation of 200 acres near point of diversion. Estimated cost $4300.00.

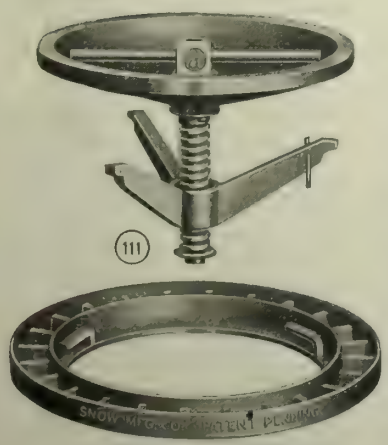
Permit No. 2508, Application No. 4141 (San Joaquin County) Issued to Mossdale Farms, Inc., Lockeford, Calif., May 26, 1926, for 3.75 cubic feet per second from Mokelumne River in Section 30, T 4 N, R 8 E, Section 26, T 4 N, R 7 E, for stock watering and irrigation of 300 acres near point of diversion.

Permit No. 2509, Application No. 4142 (San Joaquin County) Issued to N. H. Locke Company, Lockeford, Calif., May 26, 1926, for 4.19 cubic feet per second from Mokelumne River in Section 26, T 4 N, R 7 E, for stock watering and irrigation of 335.35 acres near point of diversion.

·SNOW·
IRRIGATION APPLIANCES



SNOW APEX GATES



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Permit No. 2510, Application No. 4398 (Calaveras County) Issued to Theo. Ostermann, Wallace, Calif., May 26, 1926, for 1.06 cubic feet per second from Mokelumne River, in Section 9, T 4 N, R 9 E, for irrigation of 85 acres near point of diversion. Estimated cost $10,000.

Permit No. 2511, Application No. 4474 (Calaveras County) Issued to Theo. Ostermann, Wallace, Calif., May 26, 1926, for 1.06 cubic feet per second from Mokelumne River in Section 9, T 4 N, R 9 E, for irrigation of 85 acres in Section 9. Estimated cost $10,000.00.

Permit No. 2512, Application No. 4400 (San Joaquin County) Issued to Terminous Farms Company, Stockton, Calif., May 26, 1926, for 4.96 cubic feet per second from South Fork of Mokelumne River in Sections 1 and 2, T 3 N, R 4 E, for irrigation of 397.5 acres near point of diversion. Estimated cost $5,000.00.

Permit No. 2513, Application No. 4405 (San Joaquin County) Issued to M. H. Steely, Clements, Calif., May 26, 1926, for 0.44 cubic foot per second from Mokelumne River, in Section 10, T 4 N, R 8 E, for irrigation of 35 acres in Section 10. Estimated cost $2000.

Permit No. 2514, Application No. 4901 (Yolo County) Issued to Frank L. Fisher, Sacramento, Calif., May 28, 1926, for 22 cubic feet per second from Sacramento River in Section 27, T 11 N, R 3 E, for irrigation of 990 acres near point of diversion. Estimated cost $5500.00.

Permit No. 2515, Application No. 4902 (Yolo County) Issued to Frank L. Fisher, Sacramento, Calif., May 28, 1924, for 8.12 cubic feet per second from Sacramento River in Section 36, T 11 N, R 3 E, for irrigation of 650 acres near point of diversion. Estimated cost $900.

Applications Filed

Among the applications for permit to appropriate water filed with the State Department of Public Works, Division of Water Rights, (California) during the month of May were the following:

Application No. 5007 (Stanislaus County)—John C. Droge, Tracy, San Joaquin County, Calif., for 10 cubic feet per second from San Joaquin River tributary to Suisun Bay. To be diverted in Section 14, T 4 S, R 7 E, M.D.M., for irrigation purposes on 800 acres in Sections 14, 15, 22, 23 and 28, T 4 S, R 7 E, M.D.M.

Application No. 5009 (Butte County)—F. H. Smitton, Box 117, Gridley, Calif., for 3 cubic feet per second from Hamilton Slough, Main Canal Reclamation District No. 833, tributary to Sacramento River. To be diverted in Section 36, T 18 N, R 1 E, M.D.M. for irrigation purposes on 128 acres of rice and 74 acres of general crops in Section 36, T 18 N, R 1 E, M.D.M.

Application No. 5010 (Butte Couny)—F. H. Smiton, Box 117, Gridley, Calif. for 2.35 cubic feet per second from Lateral "E," or Shaffer Slough tributary to Sacramento River. To be divered in Section 36, T 18 N, R 1 E, M.D.M., for irrigation purposes on 94 acres of rice in Section 36, T 18 N, R 1 E, M.D.M.

Application No. 5014 (Santa Barbara County)—F. W. Mathiessen, c/o Frank C. Prescott, Atty., 145 South Broadway, Los Angeles, Calif., for 1.25 cubic feet per second from Hot Springs Creek tributary to Santa Ynez River. To be diverted in Section 11, T 5 N, R 29 W, S.B.M., for irrigation and domestic purposes on 230 acres in the San Marcos and Tequepis Grants.

Application No. 5018 (Trinity County)—Viola A. Dailey, Burnt Ranch, Calif., for 1.25 cubic feet per second from Panther Creek tributary to New River. To be diverted in Section 12, T 6 N, R 6 E, H.M. for irrigation purposes on 100 acres. Esimated cost $3000.00.

Application No. 5019 (Trinity County) Charles F. Willard, 416 Fay Bldg., Los Angeles, Calif., for 25 cubic feet per second from North Fork Trinity River tributary to Trinity River. To be diverted in Section 13, T 35 N, R 12 W, M.D.M. for mining purposes in Sections 19, 20, 29, 30, 31 and 32, T 34 N, R 11 W, M.D.M. Estimated cost $30,000.00.

Application No. 5025 (Amador and Calaveras Counties)—City of Stockton, Stockton, Calif., for 60 cubic feet per second and 30,000 acre feet per annum from Mokelumne River tributary to San Joaquin River. To be diverted in Section 26, T 5 N, R 5 W, M.D.M. for municipal purposes in City of Stockton.

Application No. 5031 (Sacramento County)—Mary A. Deterding, c/o Albert Givan, 2175-35th St., Sacramento, Calif., for 5 cubic feet per second from American River, tributary to Sacramento River. To be diverted at, or any points between Section 22, T 9 N, R 6 E, M.D.M. and Section 28, T 9 N, R 6 E, M.D.M. for irrigation purposes on 411 acres in San Juan Grant. Estimated cost $3500.00.

Application No. 5032 (San Benito County)—W. A. Pack, Hollister, Calif., for 2000 acre feet per annum from Arroyo Dos Picaches Creek tributary to Pajaro River. To be diverted in Section 15, T 12 S, R 6 E, M.D.M. for irrigation purposes on 1000 acres in Rancho San Joaquin.

Completes Eastern Trip

Roy R. Hansen, Pacific Coast Manager of the Commercial Acetylene Supply Co., Inc., has just returned from a three weeks' trip to the Atlantic seaboard where he visited the home office of his company in New York City and spent several days in a thorough inspection of the plants at Bound Brook, New Jersey, and Blue Island, near Chicago. Mr. Hansen reports that his company's plans for expansion during the next year include an even greater sales activity on the Pacific Coast.

Work Starts on Big Dam

Construction work has been begun on the main dam of the $3,325,000 Arizona project officially known as Maricopa County Irrigation District No. 1, twenty miles northwest of Phoenix. One hundred men are already working on the job, it is reported, and this crew will soon be increased to a working force of three hundred, under the Carl Pleasant Company, contractors. The dam will impound water for the irrigation of 40,000 acres of very fertile Arizona land, and will be two years in building. It will be 1700 feet long, 171 feet high from the river bed, and of multiple-arch construction.

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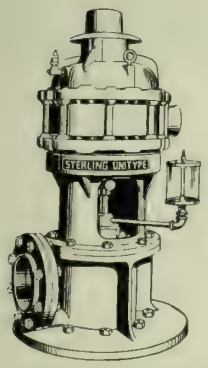

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OREGON

Fred S. Lindau of Muline, covering the appropriation of water from unnamed springs for irrigation of 10 acres in Clackamas County, and for domestic purposes.

City of Wheeler, covering the appropriation of water from East Branch of Gervaiz Creek for municipal use in Tillamock County at an estimated cost of $1000.

G. A. Miller Drainage District No. 1 of Salem, covering the appropriation of water from drainage canal of G. A. Miller Drainage District in Marion County. No estimate given.

George W. Botts of Portland, Oregon, covering the appropriation of water from unnamed stream and springs for irrigation of 10 acres, for 5.5 theoretical horsepower, domestic use and fish culture in Lincoln County, at an estimated cost of $2500.

The Oregon Iron & Steel Company of Portland, covering the appropriation for springs for irrigation of 55 acres in Washington and Clackamas Counties, and for domestic use, at an estimated cost of $1400.

Oswego Lake Water, Light and Power Company of Portland, covering the appropriation of water from Bryant Spring, Goodin Spring in Clackamas County for domestic use and irrigation in Clackamas County, at an estimated cost of $34,000.

U. S. Bureau of Reclamation covering the appropriation of water from Malheur River for irrigation and power.

David G. Glass of The Dalles, covering the appropriation of water from White River for irrigation of from 5000 acres in Wasco County, at an estimated cost of $1,000,000.

David L. Reed and John Bookout of Enterprise, for irrigation and supplementary irrigation of 80 acres in Wallowa County, from Wallowa River, Hurricane Creek and unnamed streams.

Anah Jennings of Joseph, covering the appropriation of water from Wallowa River for irrigation of 10 acres in Wallowa County.

Frank Lam of Mosier, covering the appropriation of water from Mosier Creek for irrigation of 5 acres in Wasco County, at a cost of $500.

Wm. J. F. Ashwood, C. L. Favorite and John B. Christenson of Haines, for the appropriation of water from Favorite Slough or Stock Reservoir for irrigation of 207½ acres in Baker County, at an estimated cost of $25, and John B. Christensen applies for water for an additional amount for the irrigation of 78 acres.

Dorsey F. Baker of Walla Walla, covering the appropriation of water from South Branch of Nud Creek and three developed springs, for irrigation of 38½ acres in Umatilla County, at an estimated cost of $30.

William M. Coleman of McMinnville, covering the appropriation of water from Baker and Berry Creeks for irrigation of 15 acres in the County of Yashill, at an estimated cost of $175.

Wm. J. Faubion of Faubion, covering the appropriation of water from an unnamed spring, for domestic supply for a town in Clackamas County, at an estimated cost of $3,000.

H. W. Beocher of Enterprise, covering the appropriation of water from Hurricane Creek for irrigation of 10 acres in Wallowa County.

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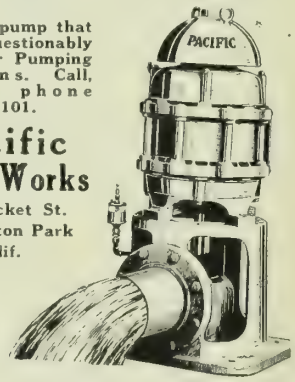

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AMONG OUR CONTRIBUTORS

Editorial Jottings About Current and Forthcoming Feature Articles, Dealing With Practical Problems of Hydraulics, and the Men Who Have Written Them

GEOGRAPHICAL breadth, if nothing more, is achieved by this issue. Look at your map of the United States and its possessions, and measure the distance from Oklahoma, in the middle of the continent, to the Hawaiian Islands, those dots in mid-Pacific. It is a long, long way, but irrigation is the basic interest affecting the agriculture of both sections and all the territory lying between. This issue spans the distance between the two points by its articles "Oklahoma is Waking Up to Its Conservation Needs" and "Irrigation Under Tropic Skies."

How irrigation is making the west a center of cotton-growing; how the Indian Irrigation Service is accomplishing its purposes; and a large number of other articles on various phases of the industry serve to emphasis the width and breadth of the subject.

H. N. CARROLL, who tells what the growing cotton industry means and is coming to mean to the San Joaquin Valley, and what part irrigation plays in that industry, was born at Carthage, Missouri, and received engineering training at the Missouri School of Mines. His experience includes engineering service for various mining and oil companies in Missouri, Tennessee, Texas and Arizona, three years in Mexico and two years in Colombia, South America, in engineering projects. In 1922 he came to the San Joaquin Light & Power Company, Fresno, California, as a sales engineer. His service for that organization involves the conduct of economic and business research studies in the various fields touched by its activities.

E. E. BLAKE is by training an attorney, by preference a conservationist, and by official position chairman of the board of commissioners of drainage, irrigation and reclamation for the state of Oklahoma. By heritage he is a pioneer, his ancestors having had places of importance in the stirring events of the American revolution, and his father being one of the early developers of the middle west. It is quite fitting, therefore, that he should assume a pioneer position in the conservation movement of his own state. He was born and spent his early life in Ohio, living on the Ohio river, where his attention and interest were first aroused to the importance of flood control. In 1889 he came to Kansas, and from there to El Reno, Oklahoma, where he practiced law in association with his brother, the late Judge C. O. Blake, until 1910, in the latter year moving to Oklahoma City. He was largely responsible, through his legislative influence, legal ability and acquaintance with flood control problems, for the passage of Oklahoma's laws affecting drainage and reclamation, and in 1925, when the legislature created a commission to assume the responsibility for state development along these lines, Mr. Blake was appointed its chairman. He is also chairman of the interstate commission of the Arkansas River States, in charge of the investigations into methods of controlling that stream and its tributaries.

RAY J. LYMAN, author of the article descriptive of the status of irrigation in the Hawaiian Islands, has been identified, in various capacities, with irrigation projects of the west during the greater part of his life, and spent four years (1910-1915) with the United States Irrigation Investigations, working on problems of research in duty of water. He was born in Michigan, but came west to Idaho in 1890, and was graduated in 1914 from the University of California. He has been president of the Great Western Meter Company, of Oakland, California, since its incorporation, and while his primary interest in irrigation is now in the metering of water, he nevertheless preserves a vital and lively concern for all constructive phases of the industry.

LESTER M. HOLT was graduated with B. S. C. E. degree from Columbian (now George Washington) University in 1902, and one month after the passage of the national reclamation act, in 1902, was appointed to the U. S. Geological Survey, in which he spent several months engaged in stream-gauging work, and was transferred to construction surveys in Colorado in the same year. He has been in government hydraulic work continuously ever since; attached in various capacities to the Uncompahgre reclamation project, geological survey work in Oklahoma, the Truckee-Carson project and other centers of government reclamation activity. He has been active in irrigation surveys, water works construction, office and designing engineering and in practically every technical phase of irrigation work. In 1904 he was transferred from the reclamation service to the U. S. Indian Office as irrigation engineer in charge of the Irrigation Section, and in 1912 became superintendent of irrigation in District No. 1, which included Washington, Oregon, Northern California and Northern Idaho. In 1918 he was made Supervising Engineer, which post he still holds.

R. F. GOUDEY, who discusses the chlorination of irrigation supplies and their use in domestic systems, is resident engineer in Los Angeles for the California State Board of Health. He was graduated in 1917 from the Massachusetts Institute of Technology, with the degree of Bachelor of Science in Sanitary Engineering, and in addition to his work with the California State Board of Health has had experience in general construction work in the east and service in the army during the late war. He has been in Los Angeles and resident engineer for the past five years. His duties include investigations of water supplies, sewage disposal and swimming pools under the provisions of the state laws dealing with these subjects.

HYDE FORBES has been introduced to the readers of this magazine in a previous issue. His article is the second and concluding installment of an interesting discussion of the need for specialization in ground-water studies. HANKINS & HANKINS are regular contributors, conducting the department on legal and judicial matters in each issue. HARDY W. CAMPBELL was formerly connected with the Southern Pacific Railway as farm advisor and colonizing agent.

W. M. MERTZ, whose article deals with "Getting the Most Out of Every Furrow," is a well-known southern California citrus grower. The first part of his article was printed in the May issue, and the two instalments together make up a paper which he recently presented to the citrus institute. Every other article in this issue was written especially for and appears exclusively in MODERN IRRIGATION.

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For 12 Months: $2.00; Single Copies: 20 cents.

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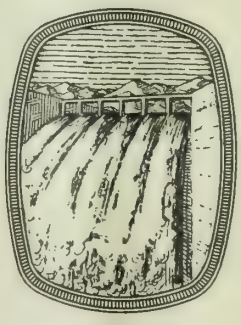
PETROLEUM WORLD 626 S. SPRING ST., LOS ANGELES, CALIF. MODERN IRRIGATION

R. V. MEIKLE

Who has tendered his resignation as chief engineer of the Exchequer project of the Merced Irrigation District after successfully carrying through the task for which he was appointed in 1924. In the construction first of the Don Pedro Dam and subsequently of the Exchequer Dam, of which he tells in this issue, Mr. Meikle has proven himself to be one of the outstanding younger engineers of the industry. He has been fortunate in having associated with him as consulting engineer A. J. Wiley, who is recognized as one of the greatest living authorities on dam design.

MODERN Irrigation
The Magazine of Applied Hydraulics



Volume II JULY, 1926 Number 7

The Progress *of* Irrigation

VIRTUALLY completed since early May, the Exchequer Dam, of the Merced Irrigation District, California, was given its formal dedication on June 23rd, and one more titanic accomplishment of large-scale irrigation development was added to the West's great record.

The attention which the Exchequer project, from the inception of activities, has commanded from the irrigation industry has been world-wide. Each step in the planning and execution of the entire task—in which the dam was only one important unit—has been carefully followed by engineers and executives throughout the irrigation country, and the completion of the work, under circumstances more than creditable to all responsible in any degree, marks an accomplishment which is not alone a triumph for the Merced district and for those who had an active part in it, but for *all irrigation.*

It is for this reason—because the entire industry shares in the honor and in the congratulation upon this big job well done—that MODERN IRRIGATION devotes a large proportion of this issue to telling the story of the Merced district, the Exchequer project, and the big dam which is its most impressive feature.

The broad outlines of this project which has just been materialized by a happy combination of engineering skill, administrative intelligence, and modern facilities of construction were conceived even before the formation of the Merced Irrigation District in 1919. Shortly after the district was organized, J. D. Galloway, a consulting engineer, made a careful survey of the district and submitted a comprehensive report to the directors. His general plan, with few notable exceptions, has been followed in the subsequent developments.

In 1924, the intervening years having been devoted for the most part to building up a working organization in the district and to developing a distributing and drainage system, work got under way for the storage units of the project. A. J. Wiley, an experienced engineer whose skill in dam design is probably more widely recognized than that of any other living authority, was retained by the district as consulting engineer; R. V. Meikle, an engineer whose work on the Don Pedro dam of the neighboring Turlock Irrigation District, had demonstrated his ability as a directing force

behind the technical work of a project of large proportions, was employed as chief engineer, and Ross White and R. W. Shoemaker, respectively, were chosen as resident engineer and electrical engineer.

Only the broadest outlines of the mammoth task which has been accomplished since the contract for the dam was signed, in August, 1924, can be suggested within the compass of two brief articles such as are presented in this issue; but some of the truly remarkable photographs which accompany the articles reinforce and supplement the written word so that the reader may gain some impression of the real significance of this undertaking.

Without much to-do, the dam has been built, the railroad has been relocated, the ten millions of dollars have been spent and the job has been finished. The engineers whose task began and ended with the construction work have tendered their resignations, which have been accepted, and a new operating organization has been selected by the directors of the district.

A suggestion of the immensity of the Exchequer Dam. This view of the temporary railroad tunnel during construction does not show the extreme thickness of the dam, however, at its base.

THIS MAGAZINE would not attempt to allot credit for the success of the project to the various individuals who deserve it. The execution of such an enterprise, of course, is no one-man job. While such men as the consulting engineer, the chief engineer, the resident egineer, the contractors, the superintendent, and others who occupy positions of key responsibility, are entitled to praise and congratulation without stint, so equally are those whose contributions, though less spectacular, are just as essential to success—the chainman on the surveying crew, the brawny, sweating laborer who was only a number on the pay-roll, the group of bond companies and the investors whose manifestation of confidence in irrigation made possible the marketing of the Merced district's securities.

The district was fortunate in having, for its governance during such a momentous period, a board of directors composed of such men as C. E. Kocher, president, E. V. Givens, Dr. C. L. Garvin, D. K. Barnell, and George Bloss, Jr. These men have directed the district through a most difficult undertaking. They carried large responsibilities and made significant decisions in unfamiliar and unexpected stuations, and did it all with sound judgment, good will, and unanimity of opinion.

Cordial relationships and co-operation between the irrigation district and the private corporations with which it was obliged to work brings into the equation still another group of men deserving of mention, and so on, from one to another in an ever-widening circle, until it seems that the project is the product, as well as the pride, of the entire industry, and a monument to what irrigation as a social and economic force has been able to accomplish in this year of grace 1926.

Exceptional and remarkable in its way as any of the engineering or structural accomplishments of the the project is the record of financial independence which the Merced Irrigation District has established. The district has financed this immense project, with the added burden of relocating a railroad, costing as much as the dam and power-house combined, without asking for outside aid from any governmental source. Its total outstanding bonds amount to $16,250,000, marketed in a business-like, orderly fashion.

The contractors on other phases of the job than the dam and powerhouse were: F. Rolandi, railroad relocation; U. S. Steel Products Company, bridge design and erection; Davis Heller Pierce Company, excavations and construction of bridge piers and abutments.

A GRAPHIC COMPARISON

These two photographs show what engineering and building skill accomplished at Exchequer in less than two years. BELOW: The site of the dam and power house in August, 1924, with the proposed dam outlined. ABOVE: The job as it appeared in May, 1926, with only the finishing touches to be added. The water had already risen in the reservoir to within 50 feet of the top of the dam, and the powerhouse was generating power for sale by the district to the San Joaquin Light and Power Co.

The Story of the *Exchequer* Project

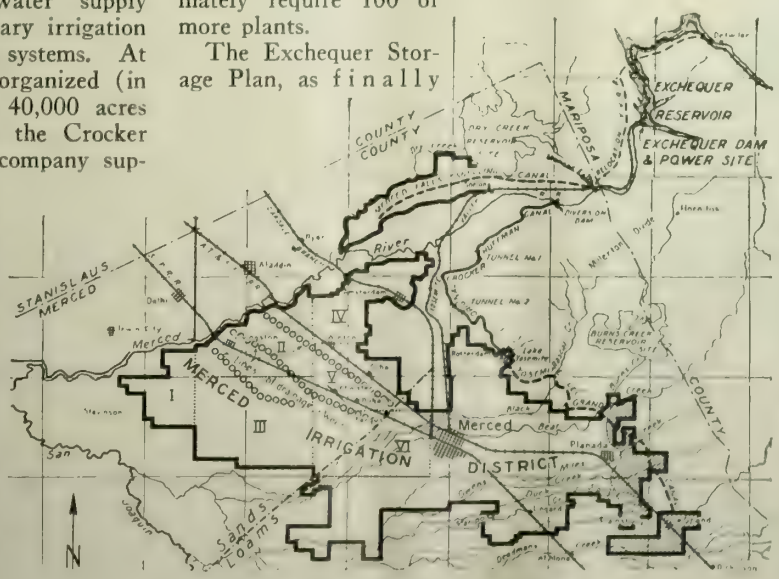
By R. V. MEIKLE

Chief Engineer of the Exchequer Project

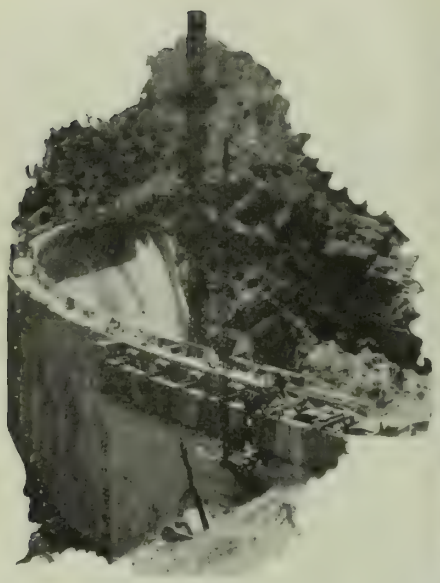
THE OBJECT of the formation of the Merced Irrigation District was to secure for its lands a full and dependable water supply and to provide the necessary irrigation distribution and drainage systems. At the time the district was organized (in 1919) an area of about 40,000 acres was being irrigated from the Crocker Huffman System. This company supplied water under contracts and the lands served were dependent upon the natural flow of the Merced River and received very little water after the first of July of each year.

The Merced District purchased the Crocker Huffman system and extended the canals and laterals to cover the entire area of 190,000 acres within its boundaries, providing for delivery of water to each 160-acre tract. A plan of drainage by pumping from wells was adopted, and 35 pumping plants were installed as the initial unit of a plan that may ultimately require 100 or more plants.

The Exchequer Storage Plan, as finally adopted by the directors of the district, provided for the construction of a concrete dam at Exchequer to impound and regulate the flow of the Merced River, for the purposes of irrigation and power, and for the construction of a power plant at the base of the dam having an average estimated output of 120,000,000 kilowatt hours yearly. To carry out this storage plan made it necessary to remove the Yosemite Valley Railroad from the reservoir site and to relocate it above the proposed high water elevation. Negotiations with the railroad company proved difficult, and the company's claim was finally settled by arbitration in November,



The Merced Irrigation District showing relation of Exchequer Reservoir to other units.



1923. The district built the seventeen miles of relocated line and, in addition, paid to the railroad the amount of the arbitration board's award—approximately $373,000.

Features of Dam

The Exchequer Dam is of the solid gravity type, arched in plan. The maximum height from stream bed is 325 feet with a thickness of 228 feet at the base and 12 feet at the top. The total crest length along the axis is 943 feet on a radius of 674 feet. A 16-foot roadway is provided on top of the dam. Mass concrete in the dam amounted to 360,000 yards, in the spillways 22,000 yards, and in the power house 8600 yards

Two sluiceways, 60 inches in diameter and steel lined, pass through the dam near the base, each controlled by one oil pressure sliding valve and one balanced needle valve, discharging from the down stream face of the dam at the side of the power house. The capacity of each sluiceway is 1000 second-feet with 125 foot head.

Two penstock openings, 96 inches in diameter and steel lined, pass through the dam to the turbines in the power house, and "Y" branches in the penstocks provide by-passes around the turbines. The penstocks are each controlled by one oil pressure sliding valve and one needle type penstock valve inserted in the penstock just ahead of the turbine. Each by-pass is controlled by a 96-inch needle-type free discharge valve imbedded in the down stream wall of the power house. The flow through each penstock is about 800 second-feet under maximum operating conditions.

An overflow type of spillway is provided at each end of the dam and each spillway is controlled by 7 14-feet by 24-feet plate steel gate leaves on steel frames with cast steel shafts and operated from a car on top of the dam equipped with a 20 horsepower motor. A concrete spillway channel from each end of the dam discharges spillwater into the river 150 feet below the power house. The total spillway capacity is 70,000 acre feet.

The contract for the Exchequer Dam included the building of the power-house, which is a reinforced concrete building 70 feet by 100 feet in plan and 90 feet high. Installed in the power house are two variable-head vertical turbines rate 17,800 horsepower at 240-foot head, but proportioned mechanically to withstand operations with full gate at 300 foot head. Each turbine drives a 15,650 K. V. A. 11,000-volt, three-phase generator at 257 R. P. M. These machines are fitted with direct-connected exciters and can be operated with safety on a basis of 70° rise in which case they will handle 18,700 K. V. A. each. The generators are connected to a single bank of step-up transformers by which the voltage is raised to 120 K. V. for deliveery to the San Joaquin Light and Power Company.

The finished dam, almost ready for dedication. The height of the dam above stream level is 320 feet, and the total pourings of concrete aggregated 374,000 cubic yards. The temporary opening left for the railroad is visible at the left. ABOVE: A side view of the dam nearing completion. BELOW: M. H. Slocum (left) job superintendent, and A. J. Wiley, consulting engineer, looking over the job.

Railroad Job Most Difficult

The relocation of the Yosemite Valley Railroad was the greatest obstacle in the way of the successful completion of the project. The old line of railroad followed close to the river and the relocated line for the greater part of the seventeen miles was directly above, making heavy shooting dangerous to the lower road where as many as twenty trains daily were operated throughout the construction period.

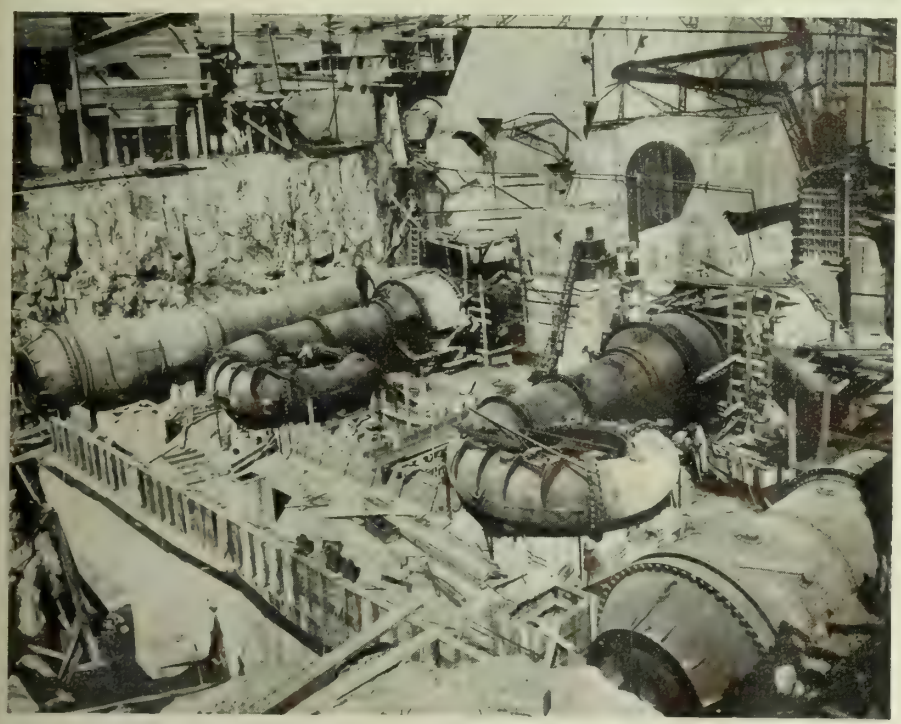
The building of the relocated line required the excavation of 1,509,078 yards of material mostly classified as rock, and the driving of four tunnels,

totaling 3,700 feet in length. Two timber trestles and five steel bridges were erected. Arches, culverts, fencing, telephone lines and station buildings completed the construction items.

The yardage excavated in railroad grading exceeded preliminary estimates by 50 per cent, making it necessary to double-shift the seventeen steam shovels to complete the work on time. All reasonable precautions were taken in carrying out this work, and as a result there were very few delays to the traffic on the main line below, in spite of the difficulties presented by the relationship of old and new locations.

truss spans carried on seven concrete piers. The two highest piers are 229 feet and 214 feet above their foundations. The bridge was erected in the remarkable time of three months.

After the three girder spans at the east end of the bridge were placed, a temporary bent was erected under the second pannel point and the first two pannels of the truss completed to this point. Two more pannels were then cantilevered and



Power house equipment being installed at Exchequer. The power house and dam were built under one contract and were rushed to completion with the purpose of supplying power and irrigation water for the 1926 season. ABOVE: A progress photo showing the dam before the power house was started. BELOW: Building the bridge, a part of the railroad relocation job. The center pier of this bridge is 228 feet high.

The rock conditions in the tunnel work provided another unpleasant surprise. They were not as good as expected, and it was necessary to timber and lag practically the entire length. The excavation was carried on by the heading and bench method and the tunnels were concrete-lined throughout, the timbering being left in place. Steel forms were used except on curves and the concrete was placed with a "concrete gun."

Interesting Bridge Job

The relocation of the Yosemite Valley railroad involved the crossing of the reservoir six miles above Exchequer Dam. The bridge at this point is 1600 feet long, made up of four 80-foot deck plate girder spans and four 315 foot

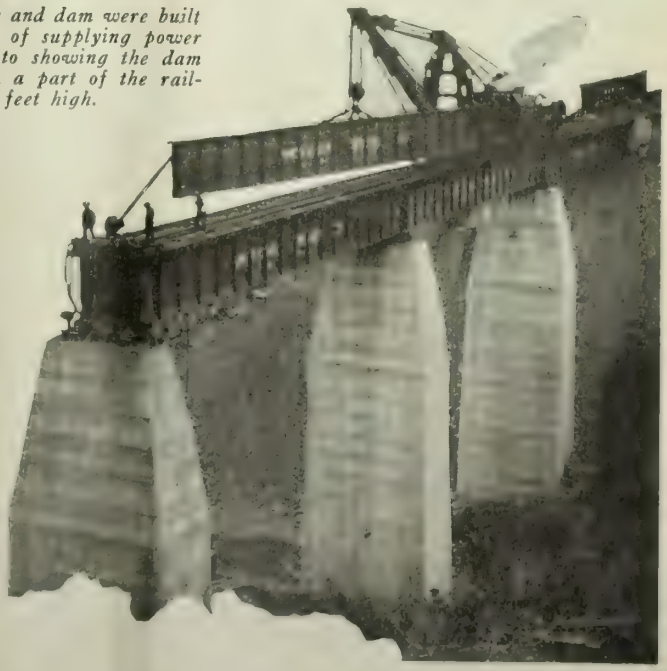
another temporary bent was erected under the fourth pannel point. The remaining six pannels of the first span were then completed to the next pier. For the remaining three spans the first temporary bent was eliminated, the cantilever being run out four pannels using the span behind for an anchor arm.

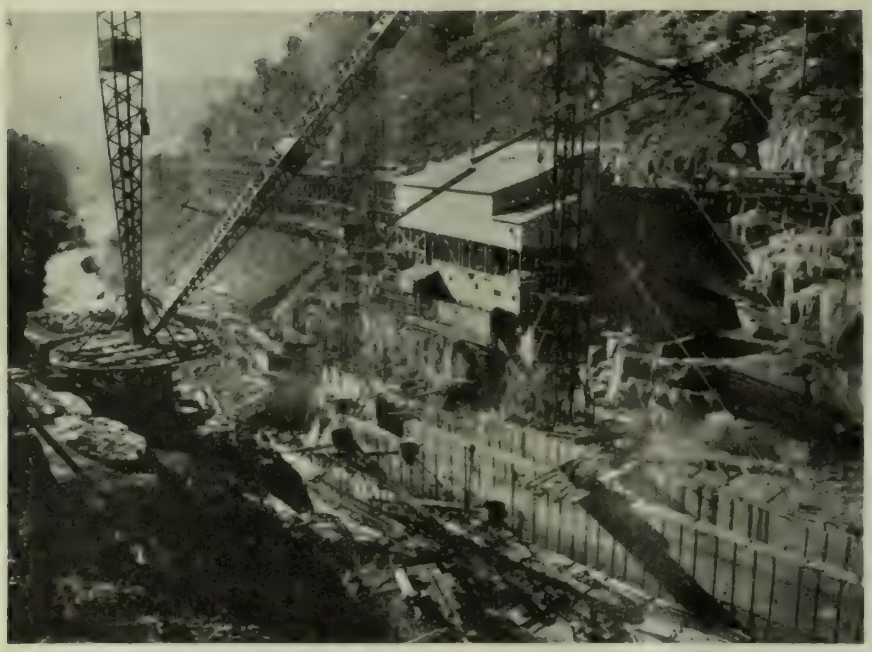
The four other bridges erected are deck plate girder spans crossing gulches running into the Merced River and average 340 feet in length. The girders are 40 to 110 feet long and are supported on concrete piers, the maximum height being 100 feet. All five bridges were erected from the new railroad which, on account of the short time available, made it necessary to construct from both ends of the railroad to the bridge across the reservoir.

Concrete Plays Big Part

Concrete represented one-third of the construction cost of the Exchequer Project. A laboratory for testing aggregates and concrete was maintained at Exchequer Dam and daily tests were made. Sand, gravel and cobbles were

(*Continued on Page 43*)





A typical scene of activity on the Exchequer Project, completed and dedicated in June, and expected to stand as a monument to the accomplishments of modern structural skill.

How the *Big Dam* Was Built in Record Time

Arthur Bent and his Brother, Stanley Bent, Tell the Story of the Construction of the World's Highest Dam at Exchequer

In an Interview with

DOUGLAS G. McPHEE

PLAN YOUR work—then work your plan. That's the secret of success in building big dams, according to Arthur S. Bent and Stanley Bent, the two brothers who comprise Bent Brothers, general contractors, and who are known as builders of great irrigation structures wherever water is impounded by concrete.

The maxim applies to many other things besides the building of irrigation works, and if this were an article for a magazine of the "inspirational" type, many excellent morals might be elicited from the experience of the Bent Brothers in this big job, based on their conclusion that the important thing in achieving such an undertaking is to lay the ground-work *right*—to have the best possible plan to follow it without deviation.

How It Worked at Exchequer

But irrigationists are more concerned in how this applies to the particular job in hand, the construction, in record time, of the highest dam in the world, built to serve 181,000 acres of California land by impounding in an excellent natural reservoir site the flow of the Merced River.

Each Dam Special Problem

"Dam construction is different from ordinary building work," says Stanley Bent, who has been in close contact with the Exchequer project from the time the first surveys were made looking toward submitting a bid on the job, "in that each individual dam presents a unique problem. There are no two alike, and hardly ever, in large projects of this kind, do they have many points of similarity. In ordinary construction work—in putting up an office building, for instance—the same thing is done in the same way until the general outlines of the task become pretty well standardized. The contractor must consider whether the haul of materials is a long one, requiring a railroad, or a short one, which can be economically handled by truck; and there are similar details to be determined for each different job; but in the erection of a dam, every detail must be planned for the particular task. Because of this *individuality* of dam construction, the most important thing in the whole job is the matter of planning."

"And this same matter may be looked at from another standpoint, equally important," added Arthur S. Bent, president of the contracting firm, formerly president of the Associated General Contractors of America, but perhaps better known in Los Angeles, his home, as president of the Los Angeles Chamber of Commerce. "So large a factor in the total cost of a job of this kind is the plan upon which it is all based—the lay-out of the plant and the method of integrating the various operations into one smooth-running machine—that the letting of the contract will, in fact, often depend very largely on which bidder has conceived the *one* right, logical, efficient plan and figures his estimates on that basis.

"It becomes doubly necessary, therefore, to get the ideal plan before anything else is done. If the contractor does not have that plan to work on, some one of the competing bidders undoubtedly will, and, with a more efficient basis of operation, will submit a lower bid and get the contract. If the contractor does have the best plan, and is awarded the contract in consequence, any change from that plan later will weaken his efficiency and lessen his margin of profit."

Cramped Quarters

How this fact was exemplified in the Exchequer dam was explained by the brothers Bent as they sat across from me in their modest office on Pecan Street, in Los Angeles, the little building from which some of the West's best examples of irrigation engineering have been directed, including the Sweetwater Dam, Lake Hodges Dam and Henshaw Dam in San Diego County, Devil's Gate Dam, San Dimas Dam and Little Rock Creek Dam, Los Angeles County, and Bullard's Bar and Kennedy Dam, in Northern California.

In this particular problem, the construction plant had to be built to fit

the narrow canyon already occupied by the Yosemite Valley Railroad. The railroad had to be kept in continuous operation during the construction of the dam. At the same time a new road was being built higher in the canyon, and while the dam was being built around the track both the operation of the road and the progress of the dam had to be maintained absolutely on schedule.

A Complicated Problem

Such a situation naturally complicated the method of operation, even after the best plant lay-out was selected, the contract awarded and signed, and work commenced. It was not feasible to store, in the space available, more than one day's supply of aggregate, or two day's supply of cement. (One day's supply of materials is not such a negligible quantity, be it understood, when concrete pourings are running around two thousand cubic yards per day).

In the face of such problems, it was the more remarkable that the contractors devised the plan that afforded an efficient system of operation, and not only overcame the difficulties, but handled one of the world's largest concrete jobs in record time.

STANLEY BENT

Bent Brothers' work on the Exchequer project included more than the building of the dam alone. The construction of power house—a sizeable task in itself—was part of the same job, and the contract involved also the delivery of all aggregate required in the railroad relocation, for concrete piers, tunnel lining, and ballasting roadbed.

"The record for prompt completion of this big job, is one of which we are very proud.

Water Needed Early

"Our contract with the irrigation district was signed August 12, 1924. The imperative need of haste, of course, was dictated by the desire to begin impounding water for gravity irrigation at the earliest possible date, as well as to begin as soon as practicable the generation of power which would mean income to the district. It was hoped that the dam could be put in use for both these purposes during the 1926 season, although to accomplish that feat would require some record-breaking work on the part of all concerned.

"In May, 1926—twenty months after the signing of the contract—the flood gates of the dam, each sixteen feet wide, thirty feet high and seventy-five tons in weight, were dropped to their places behind the openings left during construction, and water began to accumulate in the reservoir. In spite of the fact that it late in the season, it looked for a time as if the reservoir would fill to a point sufficient to assure a maximum delivery of both irrigation water and power. The lake did fill to a height of 240 feet — a point only 50 feet below the top of the dam and within a short time water was going through the power-house generating electricity for sale to the San Joaquin Light and Power Company under the terms of the district's contract.

ARTHUR S. BENT

"The largest and most important part of the time-element objective was therefore accomplished. Although it will not be possible to get 100 per cent results from the dam this year in the generation of power, it will yield an abundance of irrigation water up to the full needs of the district for the season.

"While many phases of the Exchequer job involved the setting of world records—the height of the dam, for instance, (320 feet above stream level) and the height of the bridge, the center pier of which was 228 feet high, and some of the figures for daily and monthly pourings of concrete, I think that the thing we who worked with it feel the most pride in is the promptness with which it was completed—and without any sacrifice of quality of the finished structure."

Big Things Done Quietly

Big things have been going on, up there in Merced Valley, shut away from the whole world, that the average man little dreamed of. As Mr. Bent told me of the way in which the work was conducted, it seemed to me that the most impressive thing about it, paradoxically, was the matter-of-factness and quiet modesty with which it has been carried out.

"We have had a complete little city, created for the dam and existing only during its erection," he explained. "When a construction job like this is started this temporary city is the first thing that it is necessary to build. The contractors must plan this new community with the same care that is to be excercised in every other detail of the plan. They must provide not only an efficient corps of workmen, but a community in which those workers may be contented and happy during the months that they spend on the job. They must provide homes, streets, water-works, sewage system, gas and electric service, movies churches and everything that enters into the make-up of a modern city.

"In our Exchequer city we had as many as 600 resident workers in addition to forty or more families.

"In order to give you some idea of the magnitude of this work in other than mere statistical terms," said Mr. Bent, "you might consider that the total aggregate produced for the dam and the railroad structures (our contract provided for supplying aggregate for both) was 1,000,000 tons. The average load per car when this is being transported is forty tons. In other words, if the aggregate can be conceived as all loaded on one train, the imaginary train would contain 25000 cars, and would have a length of 200 miles. This way of presenting figures is not necessary for our engineering friends, but it may interest the non-technical reader.

(Continued on Page 35)

Professional Training for "Ag" Engineers in U. C. Course

By L. J. FLETCHER

Professor of Agricultural Engineering, University of California

L. J. FLETCHER

AGRICULTURAL engineering, as a distinct division of the engineering profession, has just received additional official recognition from a leading institution of higher education in the approval, by the Board of Regents of the University of California, of a four-year technical course for agricultural engineers. The University of California is the first educational institution on the Pacific Coast to offer a professional course in agricultural engineering, and there are but eight other institutions in the United States which offer similar courses.

According to the present plan, as worked out by the faculty and approved by the Regents of the University, the course in agricultural engineering will be given in the College of Mechanics, the student spending three years at Berkeley and one year at the Branch of the College of Agriculture. The work at Berkeley will be largely of an engineering nature, while at Davis the student will enroll in courses in agricultural engineering, irrigation practice, soil technology and general agricultural courses.

It is to be noted that the professional curriculum in Agricultural Engineering is not intended to train men as irrigation engineers. There is now in the University of California a Department of Irrigation. This department offers a professional curriculum in the College of Civil Engineering for men who wish to train themselves particularly for professional work in irrigation. There is also in the College of Agriculture a Division of Irrigation Investigations and Practice. This division deals with irrigation, not alone from the standpoint of methods of application of water but also from the standpoint of the soil and plant relationships. However, the graduate in the professional curriculum in Agricultural Engineering will be well fitted to superintend farm enterprises where the operation of irrigating equipment such as motors and pumps is involved.

The Agricultural Engineering Division of the College of Agriculture is receiving an increased number of requests for men who have received professional training in agricultural engineering. Manufacturers of farm machinery have established training courses in their factories for graduate agricultural engineers. The Pacific Coast is asked to supply several men each year. Other requests have come from electric utilities, educational institutions in the west, government agencies, manufacturers of farm building and machinery equipment, and large farming enterprises. Inquiries are being received from students in other institutions both in this country and abroad concerning professional undergraduate training in this field. The results of research work being conducted by various members of the Agricultural Engineering Division are tending to focus on California the attention of prospective students as well as employers of graduates. The University of Oxford, England, has established an institute of agricultural engineering and a number of German universities have organized means for study and investigation in this field.

Meets Definite Need

There is a definite need for the establishing of this new course. The more significant feature of the progress of American agriculture during the past century has been the introduction of machine methods production. The amount of labor required to produce one bushel of wheat one hundred years ago is sufficient today, by the use of modern machinery, to produce more than twenty-five bushels. Over 80 percent of the energy expended annually on California farms is furnished by electric motors, internal combustion engines, not including automobiles, and windmills. There are more tractors used per acre of improved land in California than in any other state in the union. While the California farmer expends annually about 100 horse power hours of energy per acre of improved land in producing his crops, it is quite evident that this energy is used efficiently for the average net income per farm operator in this state is over twice the average for the United States. There is also a need for better farm structures from the standpoint of efficient use of building materials and convenience.

This agricultural engineering course, as established in the University of California, contains 113 units of required work, 17 units recommended electives and 20 units free electives. The distribution by general subjects is: science, including chemistry, mathematics and physics, 24 percent; general engineering 25 percent; general agriculture 13 percent; agricultural engineering 14 percent; cultural 5 percent; military and physical education 5 percent; free electives 14 percent.

Touches Many Points

It is the purpose of the agricultural engineering curriculum to give training in engineering fundamentals, together with such agricultural subjects as will enable correct application of engineering principles to rural problems. The agricultural engineer largely concerns himself with those engineering problems which apply to the individual farm, such as mechanical equipment for the farm; the application of power to farm operations; the location, design and construction of buildings and other farm structures; water supply and sewage disposal on the farm; the sanitation, heating, lighting and ventilation of farm buildings; labor saving equipment for the farm home; land clearing; and certain phases of the manufacture of agricultural products insofar as this process is conducted on farms.

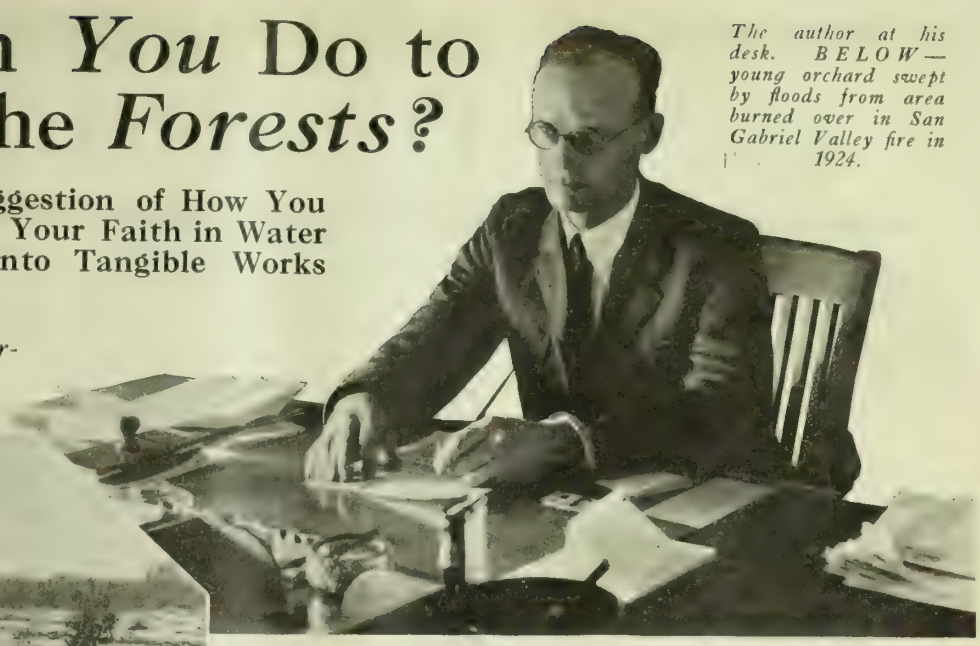
The American Society of Agricultural Engineers, which was organized twenty years ago to promote the art and science of engineering as applied to agriculture, and which held its annual meeting at Lake Tahoe in June, has contributed largely through its College Division to the building up of professional work in this subject.

The new agricultural engineering building, which is to be erected on the University Farm at Davis this summer, will provide facilities which will make possible material improvements in the courses offered by the Agricultural Engineering Division.

What Can *You* Do to Protect the *Forests*?

A Definite Suggestion of How You May Translate Your Faith in Water Conservation Into Tangible Works

By STUART B. SHOW
District Forester, U. S. Forest Service



The author at his desk. BELOW—young orchard swept by floods from area burned over in San Gabriel Valley fire in 1924.

IN THE great West we are justly proud of our highly developed and diversified agriculture. Back of that splendid agriculture lies a supply of water for irrigation without which we should never have progressed beyond the extensive grain-growing days. Water is indeed king.

Back of the water supply lie the mountain areas and the forest and brush cover which are the primary source of water control. How much is this cover worth to the water user? In a certain canyon in Southern California I am told that water is worth $30 an acre-foot. To catch 1,300 acre-feet the water users constructed a $700,000 dam, an investment of over $500 an acre-foot. In the heavy rains of last April there fell on that watershed the equivalent of 8,800 acre-feet of water, of which only 1,100 feet, or one-eighth of the total, ran off immediately. In other words, seven-eighths was held back by the cover, most of it to appear later as gradual seepage to the reservoir. Figured on an investment basis, the cover of this watershed is worth about $5,000,000, for without it, no doubt, the bulk of the rain would have run off those steep slopes at once.

Not many parts of the west can yet figure so high a value for water or for the cover which protects it. But the same problem of watershed protection exists up and down the the Sierras and Coast Range, varying only in degree.

What Can You Do?

What can the individual do to help in the forest problem, for that is the problem we must jointly solve?

First of all, he can exercise extreme personal care with fire, the enemy of the forest. In that I should include active participation in the unceasing campaign to make every individual feel a sense of responsibility for protecting the forests. The man who causes a fire is in truth an enemy to society, and it is only public pressure that will finally teach the infinitely small minority of fire causers that their activities will not be tolerated. The public agencies, however capable, can not solve the problem alone.

Everywhere in fields and forests the law says that burning matches and tobacco shall not be thrown from moving vehicles. We know it is a good law because scores and hundreds of fires are caused that way each year, but to enforce that law by direct police action is out of the question. Have you a receptacle in your car for cigar and cigarette stubs and matches, and is it second nature to use it?

On some of the most hazardous forest areas smoking is prohibited during the fire season. That again depends largely on the sense of responsibility of the individual rather than on policing. Last year a surveyor "sneaked" a smoke out in a brush patch. It finally cost some $80,000 in public funds and destroyed thousands of acres of watershed cover. Do you support the no-smoking laws and regulations?

The California lumber industry in the pine region of the Sierras and Coast Range, from which comes the water for the Sacramento and San Joaquin Valleys, cut over each year some 60,000 to 70,000 acres of forest. Part of this is on National Forest lands, where by reserving thrifty trees and saving the young growth, a forest cover is maintained. On part of the private land, on the contrary, clear cutting, the use of high-power logging machinery, and fire, leave the land with no start towards a new forest. The lumber industry would be in a far better position to take up active reforestation measures were the fire prevention activities of the state increased. Areas of young growth have a high fire hazard, and additional protection, under state leadership, is urgently needed. Because denudation of forest land is likely to affect adversely the water supply and because we need every possible acre of growing forest, the water user has a direct interest in developing a constructive state forest policy. A fine start has been made—whole hearted and aggressive action is now needed to strengthen and upbuild the fire protection machinery of the state.

The EDITORIAL

MODERN Irrigation

Published Once a Month
AT LOS ANGELES, CALIFORNIA, BY THE
PETROLEUM WORLD PUBLISHING CO. *Editorial and Executive Offices, 626 South Spring Street, Telephone Broadway 3262.* Branches: SAN FRANCISCO—447 SUTTER STREET, *Telephone Garfield 2772;* H. E. TAYLOR, *Manager.* CHICAGO—1163 MONADNOCK BLDG., *Telephone Wabash 8855;* JOSEPH E. O'CONNOR, *Manager.* NEW YORK,–56 W. 45TH STREET, ROOM 1105, *Telephone Vanderbilt 3672;* WERNER HAUPTLI, *Manager.*

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By Annual Subscription in the United States and possessions, $2.00; Foreign, $2.50; Single copies on sale in the irrigation country, 20 cents. In ordering change of address, give both the old and the new address. Allow ten days for re-entries on the subscription list. Advertising rates and circulation data upon request. Checks should be made payable to Petroleum World Publishing Co.

Vol. II JULY, 1926 No. 7

The Exchequer Project

EXCHEQUER dam and the great project of which it is a part are more than the accomplishment of a single irrigation district; they are symptomatic of the great capacities of the industry.

This issue is so largely devoted to this project, not because the dam was the highest in the world, or because the concrete pourings set a record, or because the incidental engineering tasks were so monumental and novel, but because here again irrigation has shown itself to be "big business;" and not only that, but big business independent, self-sufficient, and solvent, commanding the respect and confidence of investors, and requiring as its right the best of technical and constructing skill from the professions of engineering and contracting.

On pages 9 to 15 (inclusive) we have attempted to give a picture of the Exchequer project which would be almost worthy of the achievement itself. No story in a few pages could hope to do the big job justice, but we have, perhaps, done as much as journalism could.

Our grateful acknowledgements are due to R. V. Meikle, chief engineer, who wrote the article on pages 11, 12 and 13; and to Arthur S. Bent and Stanley Bent, of the contracting company which built the great structure and whose account of their important part of the work is told by the editor on pages 14 and 15. These are the men who played the leading parts in the construction itself; but they, like big men generally, had time for one more thing; they responded whole-heartedly and generously to the request that they give to the readers of MODERN IRRIGATION a personal glimpse of what the Exchequer is.

A Year of Service

THE FIRST issue of MODERN IRRIGATION to come from the press was dated July, 1925; the present issue marks the completion of a year in the history of the magazine. It may not, perhaps, be inappropriate to speak briefly, on such an occasion, of what it has accomplished, and of its ambitions and plans for the future.

With its first number, it enunciated the principles on which it intended to stand—the presentation of attractive and reliable material of interest and value to men active in or directly concerned with irrigation, including both technical articles by the leaders in the practices of the industry, and other matters, of less technical nature, but of equal interest to the whole hydraulic fraternity. It promised that this material would be uncolored and unprejudiced, prepared and published in the interest of no group or faction, but actuated by the motive solely of giving an intelligible voice to the great, fundamental industry upon which the West depends—which had been theretofore practically inarticulate.

The experiences of twelve months have not changed our intentions of adhering closely to this declared program; they have rather strengthened that determination. In this year, it should have been apparent to the most casual reader that the magazine, when it asserted that it was uncontrolled and unsubsidized, meant exactly what it said. It is still, as it was in its inception, the organ of the whole industry, and not of any one part thereof.

A Broadened Scope

SOME CHANGES, of course, have been dictated by what the magazine has learned during this year of existence. It soon became apparent, for instance, that in the West there is a natural and inevitable community of interest between the irrigationist and the developer of domestic water, and a department has been instituted, on a scale which is destined to grow larger, devoted to the water companies engaged in municipal and public service.

This department it is the intention of the publishers to expand into an increasingly important part of the journal, treating to a large extent the problems which affect both water works and irrigation development, as well as certain problems peculiar to the water works field and the individual concerns of that industry.

A legal department has also been instituted, giving each month in

POINT *Of* VIEW

condensed form the outstanding judicial decisions of western courts involving matters of law germane to irrigation, reclamation, drainage, and all form of hydraulic activity. This department has a proper and necessary place in a journal such as MODERN IRRIGATION, because the steadily growing body of irrigation law is of vast interest not only to lawyers but to all executives of the industry.

Overhead Irrigation

IN the early issues of the magazine a department was included, devoted to overhead irrigation, and it has become apparent that no mistake was made in conceiving this new form of water application as worthy of a separate division and prominent notice in every issue. The desire to learn more about overhead irrigation is noticeably growing among irrigators everywhere, and responsive to this desire, the magazine has set out to enlarge and improve the overhead irrigation department, with the purpose of making it indispensable to overhead irrigators and to all who are considering overhead irrigation, as an authentic guide to what is going on in that branch of the industry.

The new overhead department is introduced in this issue. A consulting overhead engineer, whose experience and contact with overhead operations has been a particularly wide and comprehensive one, has been secured to conduct this department for our readers. A feature of the department will be a "questions and answers" column in which the reader may seek and obtain expert advice on problems of installation or operation of sprinkling systems.

News of "the Trade"

ANOTHER department introduced in this issue for the first time, which will, in the future, be a regular feature, and which should be of considerable interest to readers, is that headed "Trade Notes of the Month."

The manufacturers of irrigation and water works equipment, in their natural and necessary competition, with their research laboratories and engineers in continual practical contact with the field at all its points, are doing as much as any other agency in the advancement of irrigation practices. What they are planning and doing is of real importance to the industry.

It has been the policy of MODERN IRRIGATION from its inception not to use, in the guise of news matter, the announcements of manufacturers and dealers which in reality are but modified advertising. In "Trade Notes of the Month" our purpose will be to gain the advantages of those announcements which have value for the reader and advertiser alike, without incurring the odium that attaches to the publication which is "edited by its advertisers." The material in this one department will be frankly and undisguisedly furnished by our advertisers, and should be read with that understanding. No reader is obliged to devote his time to it unless he does so for the information which it contains, which will often be of direct and appreciable value.

Farm Prosperity

CARL E. GRUNSKY, an engineer whose name and opinions are universally respected, presents in this issue his thoughts on the question of how agricultural prosperity may be promoted (if at all) by government action. Mr. Grunsky questions the efficacy of attempts to soften the incidence of unaltered economic law, by any form of subsidy or bonus. He holds up as the only permanently effective way of helping the farmer a plan for increasing the relative number of consumers. We must, he believes, undertake large public works and spend vast sums for military and naval equipment, so that as many individuals as possible shall be removed from the producing ranks and be made consumers. "This," he concludes, "during any period of over-production, can only make for prosperity."

More space than is available for this brief note would be necessary to examine these contentions fully. It ought, however, to be said that "prosperity,"—a vague term at best—will be found to consist not in an abundance of money, nor in the rapidity of its circulation, but in an abundance of goods, widely distributed. "Over-production," too, if its meaning is not properly understood, may be a misleading term. It does not mean—it never has meant—that the mass of the social group was over-supplied with goods, but that the goods were unevenly distributed; that commodities were not moving uniformly and at a fair price from producer to consumer.

Should such a scheme for economic reconstruction be followed, it might have an effect of the kind which Mr. Grunsky predicts. The rapid circulation of money has a tendency toward promoting "better business"; prices rise, and with rising prices, a fictitious prosperity would ensue but not, of course, if new wealth also had been created, as it presumably would be by the construction of good roads and other public works.

"The relatively high taxes inherent in such a policy need not be feared," says Mr. Grunsky. "They will be collected only from those who are able to pay, and who, in their turn, will share in the engendered general prosperity." Such a system of taxation has been sought by statesmen since states were, but has not, up to now, been found. It it could be found, however, the resultant benifits might even surpass, in their effect upon the economical life of the country, Mr. Grunsky's own hope for the successful application of his plan.

W. F. McClure

THE OFFICIAL head of irrigation in the state where it has reached its highest development, W. F. McClure was a figure of importance in the world of hydraulics. He held his commanding place in the respect of his profession not by the influence of official position, however, but by the force of his own ability, character and demonstrated worth.

Wilbur F. McClure—The *Man*

As Teacher, Minister, and Public Official, California's Late State Engineer Spent His Life-Time in Modest, Unassuming Service

By PAUL BAILEY
Acting State Engineer of California

ON THE AFTERNOON of June 22 official circles at the California capital were shocked by learning of the sudden death of State Engineer Wilbur F. McClure. His long term of service, his habitual friendly greeting, and his interest in public affairs made for him throughout the state many friends who mourn his loss. Mr. McClure served his State faithfully and well in the capacity of State Engineer for fourteen years. For the past three years, he was Director of Public Works and Chief of the Division of Engineering and Irrigation. His innate modesty and quiet demeanor have left a record of service little heralded before the public, but replete with honest endeavor for the public welfare.

The life of Mr. McClure has been unusual in many respects. Educated as a school teacher, he left this occupation to engage in railway location and construction, and after several years of successful endeavor became a member of the Methodist ministry. For seven years Mr. McClure held pastorates in several sections of California, but in 1900 he returned again to the practice of his chosen profession. From 1900 to the present date, Mr. McClure was almost continually occupied in public service.

He was first connected with the removal of Arch, Blossom and other rocks in San Francisco harbor and following this became City Engineer of Berkeley and, later, Commissioner of Public Works for the same city. For three years following 1909, Mr. McClure was engaged in the private practice of his profession, but in 1912 was again called into public service by Hiram Johnson, then Governor of California. In this office, Mr. McClure was serving under appointment by the third successive Governor at the time of his death. Active until the last, Mr. McClure passed away while officially inspecting a dam site near Placerville, California.

At the time of taking state office, in 1912, the jurisdiction of the State Engineer's office related principally to work in and about state institutions, with minor enterprises in road construction and rectification of river channels. During the period in which Mr. McClure was State Engineer, however, there has been a great expansion in the activities of the office. State supervision of irrigation and reclamation development and dam construction originated and grew to large proportions during this period. Engineering investigational work became an important function of the office as well.

Between the years 1911 and 1915 the California Irrigation District Act was perfected, through many admendments, to the point that it became practical for substantial irrigation development to proceed. In 1913, the California Bond Certification Commission was created by the legislature, composed of the State Engineer, Attorney General and Superintendent of Banks. Through the separate jurisdiction of the State Engineer's office under the California Irrigation District Act and the jurisdiction of the Bond Commission, the state has supervised one of the greatest expansions in irrigated agriculture that has occurred in any locality in the United States. Since 1912, over $120,000,000 of state-approved bonds have been issued for construction work through the organization of 100 irrigation districts. The total area included in these districts in three and a half million acres, three fifths of all the lands under irrigation in California. This is a greater area than is at present irrigable under all the federal irrigation projects combined.

The assemblage of the large volume of capital at low interest rates necessary to construct the works for irrigating this vast area was made possible through the successful administration of state supervision of irrigation projects. This successful administration has made irrigation securities readily purchased by the buying public. Almost without exception, these entire areas have met their financial obligations as they became due.

This great and rapid expension of the irrigated areas in California advanced conditions to the point where organization of large areas became necessary under conditions not contemplated by the California Irrigation District Act. Accordingly the California Water Storage District Act was passed by the Legislature of 1921 and the California Water Conservation District Act in 1923. Under the supervision of the State Engineer, as provided in these acts, about two and a third million acres have organized to irrigate new lands and to improve the water supply of other lands already under irrigation.

In order that progress might continue uninterruptedly and agriculture and other industries dependent upon water might further contribute to the prosperity of the state, engineering investigational work concerning available water supplies and their most advantageous utilization became one of the most important functions of the State Engineer's office during the latest years of Mr. McClure's administration. This work produced the reports upon the Water Resources of the state presented to the Legislatures of 1923 and 1925. These reports contained the first complete inventories of the waters of California and of the future needs for water in order to accomodate the full development of the resources.

Parallel with this immense program of irrigation development, reclamation of overflow lands in the Sacramento and San Joaquin Valleys has also progressed rapidly under legislation passed in 1911. The State Engineer's office has participated with the State Reclamation Board and the California Debris Commission as provided in this legislation for the state supervision of these projects.

All this work stands as a monument to the administration of Mr. McClure, and to the vision and capacities of the man.

THE HYDRAULIC DIGEST

A Monthly Bulletin Board of Brief Facts and Events from Far and Near

Boise Project Autonomous

Transfer of the operation and maintenance of the Boise (Idaho) Reclamation project to its water uses has practically been completed by the Reclamation Bureau. The Boise project is the first of the government's large irrigation projects in the west to be turned over to the farmers for operation under the new law.

Texas Reports Optimistic

Not for many years have conditions been so good and prospects so bright for farmers and stock raisers of the southwest, according to a report from El Paso, Texas. An abundance of moisture, following the drought the past few years, has supplied the factor needed to make this a banner year for producers of the arid regions of Arizona, New Mexico and west Texas.

Settlers Will Operate District

A decision to resume operations of the Hermiston (Oregon) irrigation district was made late last month by the district's board of directors. The operations will commence shortly after the first of July. It is announced that the settlers will handle all the operations, thus cutting down the operating forces and expenses.

Earlimart Plans System

A mass meeting was held in Earlimart (Calif.) in June, to discuss ways and means of securing a town water system. District attorney McCormick, of Visalia, explained the California Public Utilities Act, whereby small towns may form a water district. Shares in the company will be sold to each lot owner who wishes to make a connection.

Colorado Outbreaks Minimized

Engineers of the Imperial Irrigation District have declared that there is no cause for alarm so far as the American Imperial Valley is concerned regarding the recent outbreaks of the Colorado River in that vicinity. There are two secondary levees that stand between the Colorado and the American Valley, and the district anticipates no trouble outside the immediate region of the inundation.

Indians Want More Water

The Indians of the Salt River reservation, numbering 823, have organized for the purpose of increasing their water allowance to an amount necessary for the proper irrigation of their three thousand acres of land now under cultivation.

More Flood Guards

A proposal that the federal government and the county share equally in the cost of safeguarding tide flats from Puyallup river floods, has been made by the Tacoma Chamber of Commerce. This proposal will be submitted to Congress through the District Engineer's office.

San Carlos Progresses

Plans and specifications for the San Carlos (Ariz.) irrigation project and dam are nearing completion and bids will be called for at Phoenix and elsewhere within the next sixty days. Government authorities have expressed the hope that the first earth on the project would be turned by the first of October at the latest.

Olympia Has More Water

Two artesian wells, delivering 576,000 gallons of water each 24 hours into the city water mains of Olympia (Wash.), were tied into the city water system recently. One of the wells delivers 175 gallons and the other delivers 225 gallons per minute. City officials assert that with this added supply, Olympia will not experience a water shortage even in the driest of seasons.

Bolinas Gets Water

The State Division of Water Rights has granted the application of the Bolinas Public Utility district for one second foot, or approximately 650,000 gallons a day, from the Arroya Honda Creek in Marin county (Calif.). The water will be used as a municipal supply for the Bolinas district, which includes the town of Bolinas and about 1000 acres of unincorporated territory. A low concrete dam and nine miles of pipe line are to be provided at an aggregate cost of $50,000.

Imperial Will Rebuild Dam

Application has been made by the Imperial Irrigation district (Calif.) for permission to repair and rebuild its temporary diversion dam across the Colorado River at Hanlon's Heading, California, for the purpose of raising the water elevation during its low-water stages sufficiently to divert the amount needed to supply the Imperial District during the season 1926-27.

Lower Court Sustained

The Supreme Court of Oregon rendered a decision on June 1, affirming the decision of the lower court and approving the sale of surplus water from the Warmsprings Irrigation District to the government for the Vale, Oregon district. The decision of the court was unanimous and was rendered by Justice Belt. It constitutes final approval of the law passed by the 1925 legislature, which made the sale of water by the district a lawful procedure.

Lomita to Vote on System

Lomita (Calif.) is preparing to hold an election, which will perhaps be called by the county board of supervisors near the middle of July, to determine whether or not a county water works district will be formed. It is estimated that the system will cost approximately $380,000, and asserted that when the plant is completed it will be among the best in Southern California, owing to the large underground flow of water which can be obtained there.

District Votes on Contract

On or about July 10, voters in the Payette-Oregon Slope Irrigation district will ballot upon the contract with the United States for their proportionate share in the construction costs of the Owyhee District. All the preliminary details of this action have been taken care of, and if the voters pass upon the contracts, all that will be necessary will be the approval of the Secretary of the Interior and the decision of the district court on the validity of the contract. It is expected that the middle of August will be reached before final action can be expected.

HYDRAULIC ENGINEERING

Dealing with the Practical Problems of the Operating and the Consulting Engineer

Taking the Temperature and Feeling the Pulse of the Test Dam on Stevenson Creek

By R. W. CARLSON

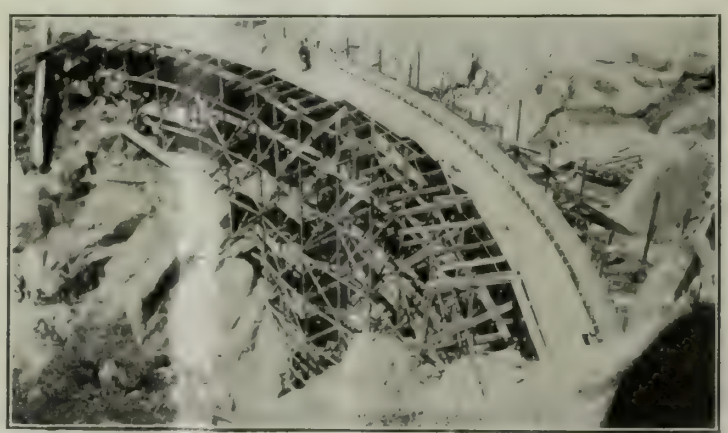
UNTIL recent years, arch dams have been designed in a very elementary way. The concrete has been assumed to carry loads without being deflected or strained and the arch has been treated as a portion of a rigid cylinder. The method for calculating the thickness of an arch section for assigned conditions has been too simple to be fascinating.

Increasing knowledge about concrete and increasing investments in arch dams has brought a flood of refinements in design. All of these refinements have been required in recognition of the well-known fact that concrete deforms. Perhaps the first of these has been to take account of the effect of temperature changes on the length and shape of the concrete arch. The second has been to include the effect of shortening and bending of the concrete arch under the water load. Next has been to compute the load carried by the vertical beam sections and reduce the load to be carried by the horizontal arch sections by this amount. Other refinements have been the analysis of the effect of lateral expansion due to load, the effect of shear, the effect of shrinkage, the effect of moisture absorption, and other important but very uncertain conditions.

Before new developments can be made standard practice, the magnitude and importance of the score of actions which shall determine rational design must be evaluated. Meanwhile, to insure safety and cover uncertainties, arch dams are presumably being built many times stronger than calculations demand.

Realizing the certain gain in knowledge and economy which will accrue, the Engineering Foundation is sponsoring a full-sized test-to-destruction of a concrete arch dam. The site is located in the steep canyon of Stevenson Creek in the Sierra Nevada Mountains sixty miles east of Fresno, California, where the storage of water will be small and no damage can result from the ultimate failure.

ABOVE: *Author reading a telemeter, one of the many instruments used in the Engineering Foundation Dam.* BELOW: *The completed dam before the forms were removed.*

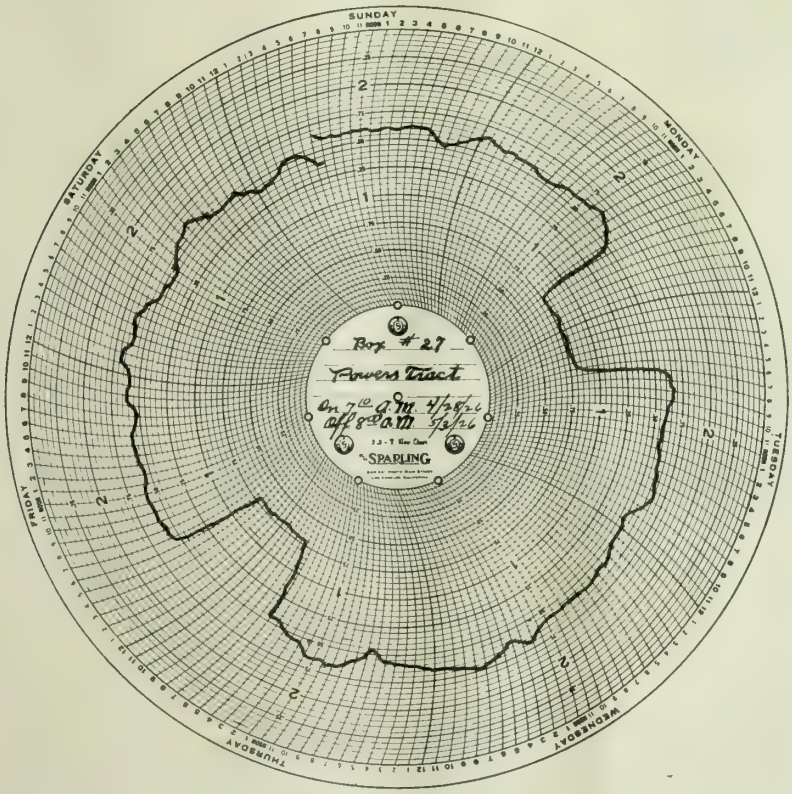


The dam has been completed to a height of sixty feet and will be tested extensively before being built higher. It is an unreinforced single arch of 140 foot crest length, 100 feet radius, seven and one-half foot thickness at the base, two foot thickness at the thirty foot level, with no change in thickness from that level to the crest. The abutments make angles of forty-five degrees with the horizontal on either side of the canyon, and the central portion of the foundation is a vertical arc of twenty-five foot radius. The concrete is uniform throughout and numerous tests of samples indicate that it is capable of supporting more than two thousand pounds per square inch.

METERS AND GAUGES

Since the distribution of stresses depends upon deformations of the concrete, elaborate preparation is made for measuring the minute internal and external movements. To measure extension or shortening, five hundred ten-inch distances (between steel plugs systematically located on the surfaces of the dam) are measured from time to time to a ten thousandth of an inch with strain gauges. The change in inclination of the downstream face of the dam are measured at sixty stations to a thousandth of an inch in five feet by a five foot vertical clinometer. The changes in curvature of the horizontal arch sections are measured at some fifty stations by means of an especially designed

"A Record That No One Can Question"



Facsimile of an eight inch water flow record chart from the new 2.5 foot range Sparling canal level Recorder.

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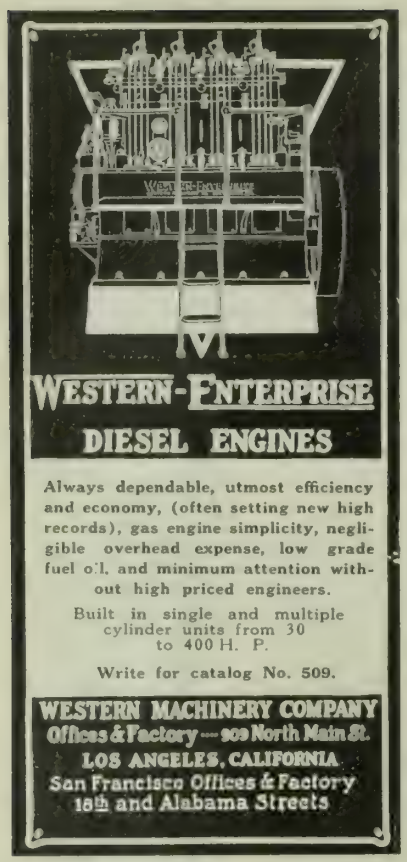
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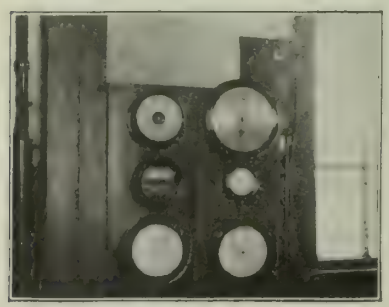

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change-of-radius meter. The movements of central portions of the dam upstream or downstream are measured from the sides of the canyon by means of surveyors' theodolites with telescopes of high power. Measurements are to be made to detect tilting of the foundation at five stations by placing an especially designed level bar on heavy I-beams anchored and grouted in the rock. Separation of the dam from the foundation at some points has already been found by measuring gauge lines spanning from the foundation to the dam. Internal distortions and temperatures are measured by 140 carbon resistor strain gauges (known as telemeters) buried in the concrete.

From the data obtained by the various instruments, all types of movements can be determined and checked. Both vertical and horizontal bending of the arch can be computed independently from data from the vertical clinometer, the change-of-radius meter, and the telemeters. Movements of the central portion of the dam as a body can be obtained directly by the theodolites and vertical clinometers and checked by the telemeters, strain gauges, and change-of-radius meters. Total tensile and compressive strains, independent of bending, can be measured by the strain gauges and telemeters.

How the Telemeter Works

The telemeters are a product of the United States Bureau of Standards and are a relatively recent invention. Each telemeter consists essentially of a stack of carefully prepared, carbon rings supported between two end-pieces of steel. The stack is protected by a collar of steel which does not interfere with the movement of the end pieces. Electrical leads from without the cartridge are connected to the two ends of the carbon stack. When the end pieces are brought closer together, the contact between the carbon rings is improved and an electrical current flows more readily. Having once calibrated a telemeter, it is a simple matter to detect any relative movement of the end pieces by measuring the ease with which an electric current flows through the stack. When a telemter is buried, the end pieces are bonded to the concrete and any internal movement in the concrete affects the distance between them and consequently affects the electrical resistance of the stack. As small a movement as two millionths of an inch per inch of length can be detected with some certainty. In fact, in the experimental dam, the free expansion or contraction due to the change in temperature which occurs in a few minutes has definitely been obtained.

The experimental dam is built with a very small factor of safety. With the reservoir filled, it would be unsafe to make measurements on the downstream face without knowing something of the stresses in the concrete. It is here that the telemeters have an added utility of great importance. For they are wired to a control station above the dam where there is no danger. Enough readings can be made and interpreted in a few minutes times to show with some assurance whether or not the dam is safe. If it is safe, observers can obtain readings of all instruments. If it is not safe, readings of the telemeters can be taken without danger until the very time that the dam bursts. These are the readings which reveal the greatest differences between calculated behavior and actual behavior and are therefore of utmost value.

Tests to Be Fruitful

The reservoir has not been filled as yet, but tests are being made regularly to study the effects of shrinkage, unequal heating, curing of the concrete, and other necessary items. It has been found that each morning when the sun begins to shine on the upstream face of the dam, the central portions begin to move upstream. The cracks between the abutments and the dam on the upstream side begin to close up, the pressure on the upstream toe of the lower portion of the foundation increases, while noticeable bending takes place throughout the dam. In the afternoon, the dam deflects downstream again and returns to its early morning position. The largest upstream movement observed in a single day has been a twentieth of an inch. On account of the movement while the sun is shining on the dam, it is necessary to make the principal observations between midnight and sunrise so that the results represent the equilibrium conditions of the dam.

The concordance between measurements with the various instruments is decidedly satisfactory. Every indication is that no large eccentricity of behavior of the arch will be missed. By pushing the test to the limit and being able to read distortions until the last minute, before failure, there is little question but that the tests will be fruitful.

New Cement Manager

J. E. Jellick, for the last three years district engineer in charge of the Los Angeles office of the Portland Cement Association, has been appointed manager of all the Pacific coast offices. He will make his headquarters at 785 Market Street, San Francisco.

For Detailed Listings, Branch Offices, Etc., See the Buyers' Guide to Leading Supply Sources—Pages 55-56

Engineers Invited to View Concrete Pipe Tests

The California Associated Concrete Pipe Manufacturers hold their mid-summer convention at San Jose on July 10, with a program especially designed for engineers and others who wish an insight into the rapidly growing industry of concrete pipe manufacture.

There are approximately fifteen thousand miles of concrete pipe installed in California alone and more than two thousand miles being manufactured per year to meet the ever expanding fields for standardized concrete pipe. As a feature of the convention the Manufacturers Association will present a series of public tests on irrigation, sewer and culvert pipes, to show the range of uses to which these products are adapted.

Hydrostatic tests will be run on single units and laid sections of concrete pipe to show their resistance to internal pressures when used as conduits for carrying water under pressure heads. The imperviousness and tensil strength of non-reinforced and reinforced concrete as manufactured by various methods will be brought out by the hydrostatic tests.

Crushing Tests Planned

Crushing tests will be run on single sections of both plain and reinforced pipe to show their resistance to external loads. The materials, gradings, proportions, and methods of manufacture will be exhibited for each specimen tested, and score cards will be furnished to all visitors who desire to keep records.

The tests will be held in the yards of the Merritt Company, 1700 South First Street, San Jose, Calif., where a modern manufacturing plant will be in operation so that visitors can view the manufacturing process in all its details, for "machine-made" concrete pipe.

The following is a condensed outline of the tests to be made:

1. *Irrigation Pipe:* Hydrostatic tests on light laid lines of 12-inch concrete pipe showing three types of reinforcing, two types of joints and ten tests on individual sections of pipe.
2. *Sewer Pipe:* Hydrostatic tests on light laid lines of concrete sewer pipe as used in sanitary sewers of Palo Alto and Yuba City, and 22-inch Watsonville pressure sewer outfall. Also crushing test on individual joints of above pipe.
3. *Culvert Pipe:* Crushing tests on four types of plain and reinforced concrete culvert pipe.

McNary Bill Meets Defeat

By a vote of 45 to 39 the McNary farm bill was defeated in the Senate in June after a long and hard battle. Charles L. McNary, Oregon Senator, was the measure's legislative sponsor.

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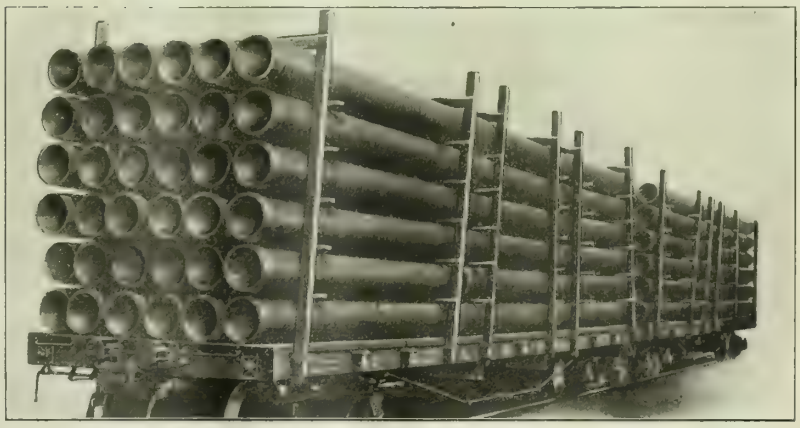
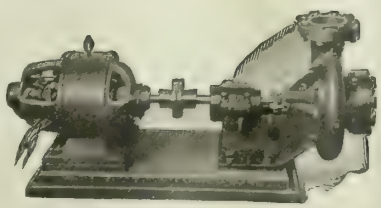


GOULDS PUMPS



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IRRIGATION MANAGEMENT

DON'T ABANDON CULTIVATION, FELLOW IRRIGATORS

By R. P. LEHR

WRITERS ON agricultural subjects within the past few years have given considerable attention to cultivation in its relation to the conservation of soil moisture. Often, in fact, other equally important aspects of cultivation have not been treated with the fullness which their importances deserves.

If our consideration of cultivation is restricted to so narrow and incomplete a viewpoint, we may be apt to disparage cultivation as a practice simply because it probably does not conserve moisture as effectively as we formerly believed. But, we must scrutinize the complete mission of the cultivator as a crop producer, for, in the final analysis, water is applied to soil for crop production and this is also the aim of other cultural operations. To put the matter briefly, it will always be important and necessary for us to till our soils thoroughly even though it may be demonstrated that cultivation is not an effective moisture saver, insofar as surface mulches are concerned.

There are a wide variety of cultivation methods but the only one which will be discused here is the deep type of cultivation which has been found most effective in thorough aeration of the upper twelve inches of soil, and for breakage of such hard formations as we know by the names of plowpan, plow sole, irrigation harpan, etc. There are, of course, many shallow methods of cultivation such as accomplished by the pegtooth harrow, spring tooth harrow, disc harrow and other shallow cultivators. These will not be treated here, for they are simply methods of surface mulching to save moisture, and are possibly not effective enough to pay the costs, although as weed-control measures they are well worth while.

Seepage Is Necessary

Primarily, thorough breakage of the soil column is important to permit good seepage of irrigation waters. These should not stand upon the surface long enough to drain into the low contours, thereby washing soluble material from adjacent ground and concentrating it in the low spots. Water should not stand upon the surface long enough to destroy the bacterial life in the top twelve inches of soil, and, in some classes of soils and climate, it should not stand in the upper soil long enough to permit baking. If these detrimental effects are to be avoided in irrigation, thorough deep cultivation must be practiced, not only during the season in which weeds are a hindrance to the crop, but even after objectionable weeds have been successfully controlled. The reason for this lies in the fact that cultivation is important as an aerator.

When we enter this subject, we reach the complications of soil chemistry and biological phases which the careful student now concedes to be equally as important as the conservation of moisture. Aeration determines the degree to which chemical reactions in the soil can progress. This is particularly true of our beneficial acids. Chief among these are found carbonic acid and those of the nitrogen group.

We find also that such important constituents as lime, sulphur and iron are essentially affected by aeration. Oxygen plays a very important part in the conversion of all these materials into crop, for they must first be oxidized and dissolved before the plant can utilize them. A piece of glass buried in the soil will be delicately etched by roots which pass along its surface. This etching is accomplished by the acids present, and oxygen is of prime importance in the complicated organic and inorganic processes by which these acids are produced. Our beneficial soil acids are the means of breaking down soil grains into soluble plant food. Without these beneficial acids our soil grain remains an insoluble particle of rock dust. Oxygen plays as important a part in this change as it does in the change of the iron particle into rust which is a soluble oxide of iron.

Soil oxygen introduced by thorough cultivation is also of prime importance to bacteria life in the soil, i. e. it is of value to the general classes of beneficial bacteria. The term "bacteria" is here used to embrace all the lower forms of organic life within the soil, rather than those in particular which are probably low forms of animal life. We know that these forms of life are seriously hindered in development by a lack of oxygen. We also know that other detrimental forms of bacteria develop when oxygen is lacking, providing conditions for their nutrition are favorable.

Soil bacteria are responsible for the production of carbonic acid in the soil. This acid is of prime importance to all crops producing starch or sugar, for from this carbonic acid is obtained the carbon dioxide so useful to the leaf system where it is received in the form of a gas and converted in the plant laboratory into crop. Therefore, we see that thorough deep breakage is necessary in order that these low organisms may have life-giving air because deep breakage allows this valuable gas free access to the surface and to the air from which the leaves remove it.

A soil allowed to "crust" is greatly hindered in ability to "breathe," or replenish its supply of oxygen by means of changes in barometric pressure and temperature during the day and night.

Europe Leads in Study

I do not know why this subject should be more exhaustively investigated by soil chemists in Europe than it has been in America, but this seems to be the case. They seem to be ahead of us in acknowledging and demonstrating these facts. In this country we accept readily what we see at the surface of soil problems but apparently are not particularly interested with the more complex and important reactions upon which successful crop production is largely dependent.

It is conceded by most of our prominent agricultural authorities that cultivation is becoming more important as the science of soil treatment becomes more comprehensive. The corn grower of the central states knows that he can grow a fine crop if he cultivates thoroughly right throughout the season, even

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after his weeds have been controlled. He may not know that his tillage operations are assisting chemical processes in the land and the various forms of bacteria life that work there but such is the established fact. It is not necessary for him to cultivate to conserve moisture, for in average seasons he has an abundance of it.

The Hopi Indian grows a crop of corn by his intensive methods of cultivation, even where agriculturists sent to him by the government turn away in dismay. He thinks that he cultivates his corn to destroy bugs and devils sent to take away his food. It can hardly be said that the sandy soil holds its moisture better from his cultivation methods. It is a fact, however, that he is unknowingly assisting other agencies upon which the root systems of his crop depend for food.

In analyzing our problems of cultivation, we must not discard our cultivation simply because we may learn definitely that it does not prevent evaporation of irrigation water from the surface soil. It would be equally unjust to condemn the cow if we were to discover, by some exhaustive research, that her milk was not actually beneficial in the cure of tuberculosis, as formerly believed. The value of a cultural process must be weighed from all angles. It would be folly to abandon it on the discovery that it is lacking in one particular.

Irrigation Shortages Predicted on Federal Projects

Water supply conditions on the federal irrigation projects of the West are described in a statement issued through the Bureau of Reclamation as slightly below normal.

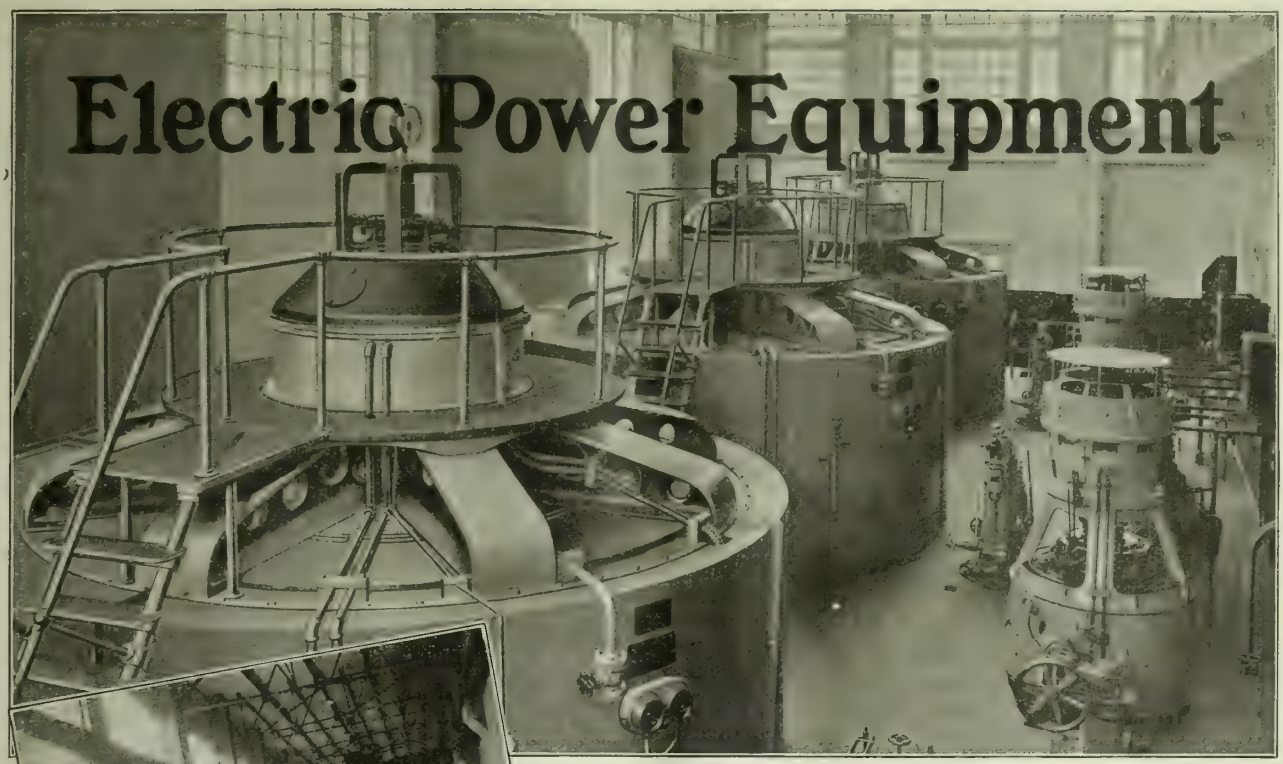
With the exception of the state of Colorado, irrigation water to be derived from snow will not be up to normal with deficiencies in run-off probably most marked in the Pacific northwest.

Light irrigation shortages are anticipated for the Milk River project, Montana, the Umatilla project, Oregon, and for the Truckee lands of the Newlands project, Nevada, although in the case of the last named, conditions are more favorable than at the end of April. A serious shortage now appears unavoidable on the Okanogan project, Washington. All other Reclamation projects are at this time assured of an ample supply of irrigation water.

The Colorado River may reach very low stages in late summer, owing to abnormal conditions in the Green River Basin in Wyoming, which may result in a deficient supply for the Imperial Valley of California.

For Detailed Listings, Branch Offices, Etc., See the Buyers' Guide to Leading Supply Sources—Pages 55-56

Electric Power Equipment



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WITH THE WATER COMPANIES

Of Interest Expressly to Water Works Engineers, Superintendents and General Managers

How Beverly Hills Met the Hydrogen Sulphide Problem in Its Domestic Water

By RAY L. DERBY

Sanitary Engineer with the firm of Salisbury, Bradshaw & Taylor, Los Angeles consulting engineers. Mr. Derby has been devoting his attention for more than a year to the special problem discussed in this article.

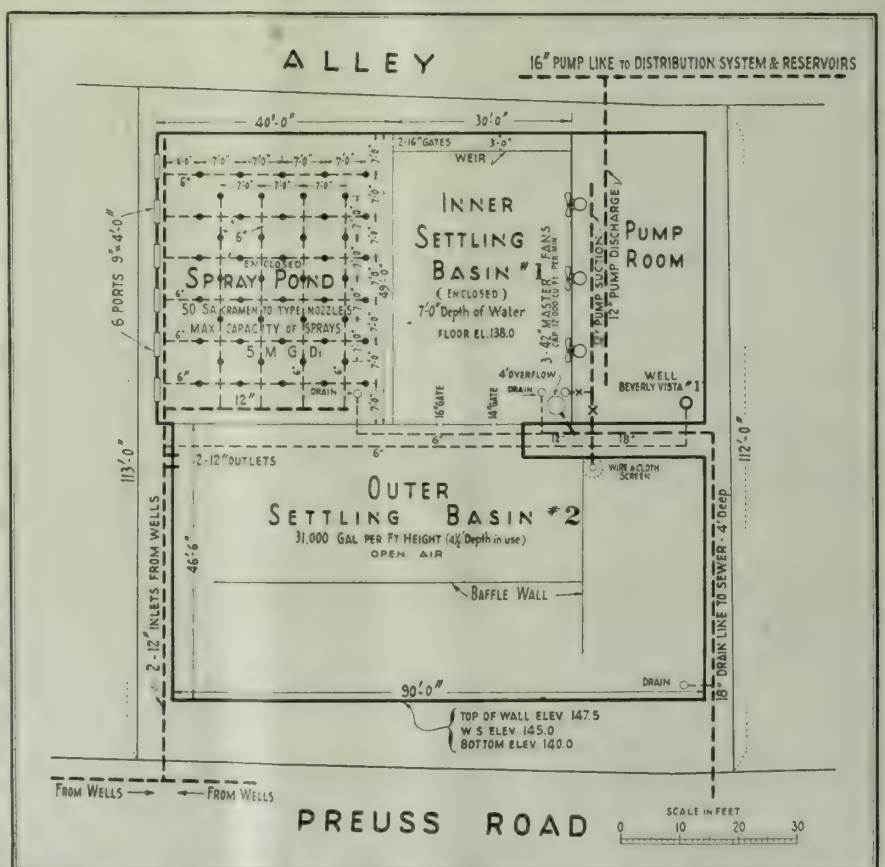
THE HYDROGEN SULPHIDE problem in Beverly Hills, California, has given rise to three distinct problems, viz; the elimination of H2S from the water; the treatment of the H2S in the air given off by the water, and the treatment of tastes and odors due to algae growth aided by the chemical composition of the water. It is the purpose of this article to deal with the first two phases only. The third phase, though closely related to the first two, is outside the scope of the present article.

A brief history and description of the water system of Beverly Hills will first be given so what follows will be more easily understood:

Outline of Situation

The city of Beverly Hills is a strictly residential community, lying about ten miles west of Los Angeles. The residences are all of the high class type, one-third or more of the area being devoted to estates of one-half to ten acres, on which lawns and shrubbery abound. Many residences have swimming pools of 20,000 to 100,000 gallons capacity. The water consumption varies greatly with the seasons, the summer demand being about double that of the winter.

Since the 1920 census, which gave Beverly a population of 674, the growth has been rapid until at the present time it is estimated to be at least 11,000. The water consumption has jumped from a maximum summer demand of 1½ m.g.d. in 1924, to 3 m.g.d. in 1925 and nearly 4 m.g.d. at present, (May 1926).



Diagrammatic layout of Beverly Hills plant for treatment of hydrogen sulphide gas in domestic water supply. The outer basin is the latest unit to be added to the plant.

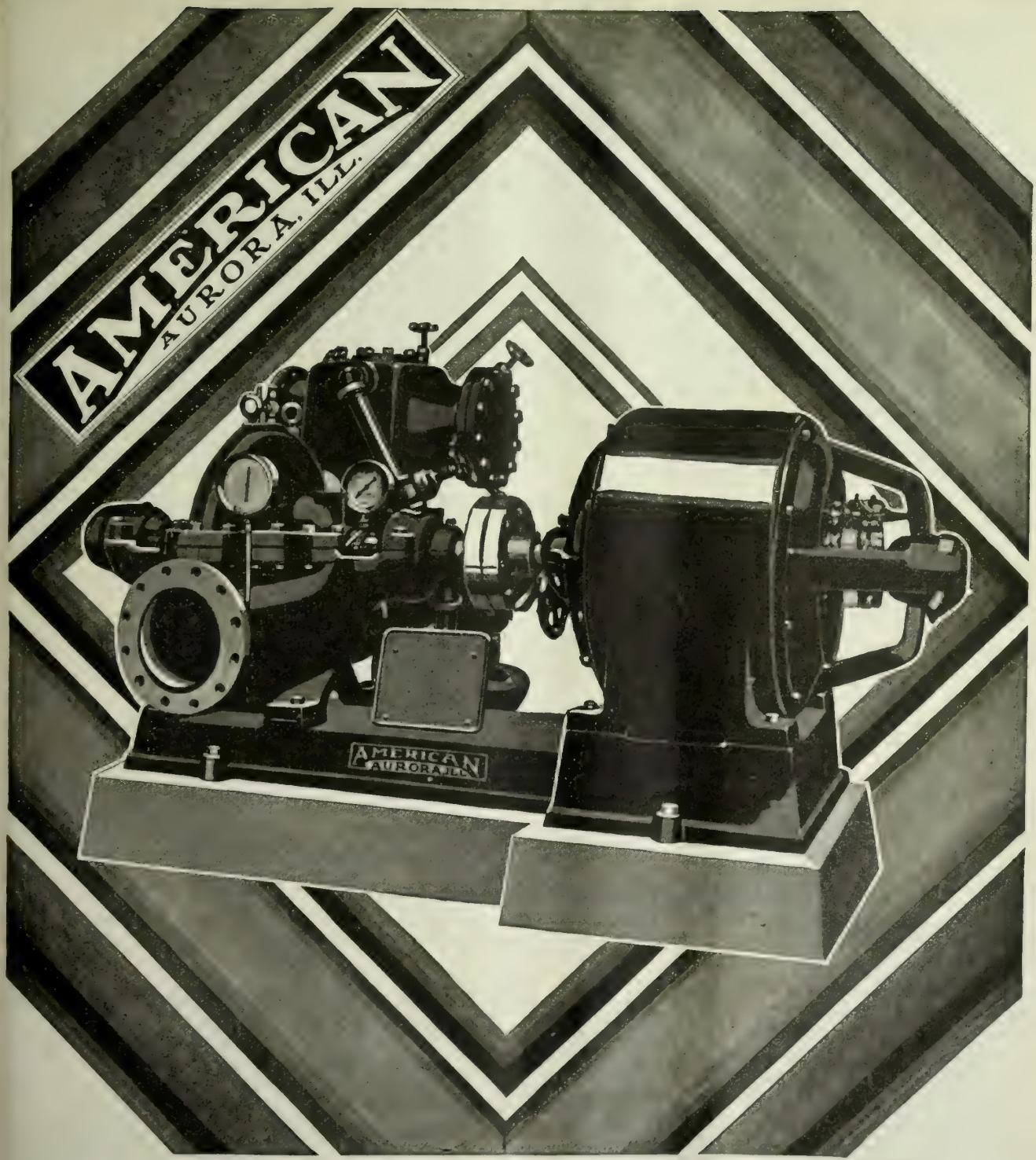
There are two distinct sources of supply for Beverly Hills:—a small supply comes from two wells known as Franklin Nos. 5 and 9 at the junction of Franklin and Coldwater Canyons. This source contains no H2S, or iron, and is relatively soft and of low total solids. Table 1 tabulates the several sources of supply as to quantity and characteristics.

The main supply is developed in the southern part of the city in what is known as the La Cienega Basin. It is in this basin that H2S is found in the water. The geology of the Basin is interesting: Of the 11 wells put down within a radius of less than one-half mile, no two have shown comparable logs or water. Wells but 600 feet apart have furnished radically different water, such as Beverly Vista No. 1, which is less than 700 feet from the Willows group. (See Table 1).

Yields Differ Widely

Another well drilled but 600 feet from City No. 1 gave no H2S but was highly charged with methane, and was so highly mineralized that it was necessary to abandon it. The total mineral content was 146 gr. per gal., or nearly 2500 ppm.

Prior to January 1924, the only wells in the La Cienega Basin were the Willows group. But little trouble had been encountered up to this time, as the Willows wells were low in



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H2S, which was amply taken care of by a small aerator. Aside from the hardness of the water, no complaints were made when the wells were used.

With the beginning of 1924, the city took over the water system and, due to the rapid growth, additional wells were drilled; the first three being the Gold Seal Group. As these all showed H2S from the start, it was decided to build one central plant to aerate all water that might be developed from this basin in the future. This aeration plant was first put in operation in June 1925.

The original plant consisted of the spray pond, weir chamber, settling pond, and pump room. The spray pond contained 30 nozzles of the type developed at the Sacramento Filtration Plant by Prof. C. G. Hyde of the University of California. The nozzles were spaced on 7-foot centers and had a maximum capacity of 3 m.g.d.

the writer is now working, and about which more will be said later.

About a month after the plant was placed in operation, complaints began to come in about tastes and odors in the water, and from sparsely built-up sections calls came in about "black and inky" water. The complaints of tastes and odors were of two classes, and were confined chiefly to different localities at first. One taste (or odor) was of distinctly H2S character and occurred principally near the aeration plant, or in localities not much built up, where the water might tend to "dead end." The other taste was variously described by irate citizens as "musty," "moldy," "old rain barrel," or "old gunny sack" and occurred at first in localities remote from the plant, but soon became general. This latter was caused by algae, but will not be dealt with here.

From the nature of the complaints of H2S, and "black water," it was thought

TABLE 1

Well	Size of Casing	Depth Feet	Yield Miners Inches	H2S P.P.M.	Hardness ($CaCO_3$) P.P.M.	Total Solids P.P.M.
City No. 1	16	383	52	0.3	243	471
Gold Seal No. 1	16	315	24	0.3	261	581
Gold Seal No. 2	16	324	48	0.3	282	536
Gold Seal No. 3	16	419	29	1.0	170	621
Willows No. 1	10	320	34	0.2	230	606
Willows No. 3	10	540	33	0.1	402	627
Willows No. 4	10	298	20	0.5	421	555
Beverly Vista No. 1	16	296	15	....	205	396
Tatum No. 1	15	340	25	....	208	620
Pruess No. 1	14	367	50	....	314	487
La Cienega No. 1	14	290	65	....	168	568
Franklin No. 5	16	85	30	0	233	325
Franklin No. 9	16	86	15	0		

From fear that the H2S evolved by the sprays would be objectionable, the entire building was housed over, allowing a 4½-foot space between the maximum water surface and the ceiling. At the end of the building over the sprays were four 4x5 down takes, and in the partition between the settling pond and the pumps were placed three 42-inch fans of 12,000 cubic feet per minute capacity each, discharging into 48-inch stacks to a point 30 feet above ground.

It was hoped that the H2S evolved would be carried up high enough to be sufficiently dissipated, so that no nuisance would be created in the neighborhood, at least at that time when the neighborhood was but sparsely settled. Due to the density of the gas and the trade winds, which are nearly constant in direction, and very strong in summer, the dissipation of the gas into the air was not as thorough as hoped for. This has given rise to a problem upon which

that the aeration was inefficient, so that tests were at once made with the following results:—

	(P.P.M. of H2S)
Water at inlet to plant	8.2
Water under sprays	4.3
Water at outlet to settling pond	3.6
Water in pump room	3.0
Water in pump line 3800' from plant	0.8
Water in pump line 8000' from plant	0.4

From these results, two things are outstanding: viz., that the aeration was inefficient, and that time is a great factor in the elimination of H2S.

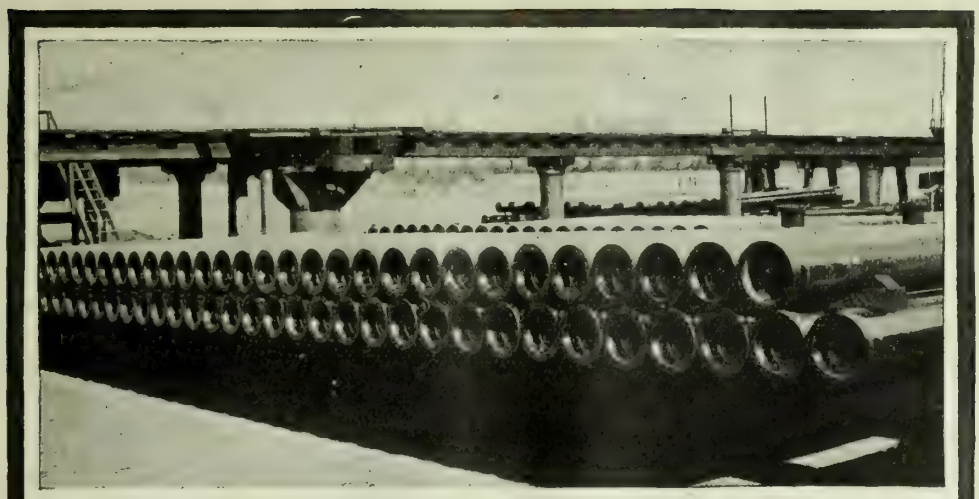
With the low volume, 1½ m.g.d. in 1924, and the wide spacing of nozzles, the sprays did not have sufficient interference properly to break up the water for complete liberation of H2S. To aid in this a positive pressure blower of 450 cubic feet per minute at 5 pounds was installed, and perforated air pipes were placed in the weir chamber.

Tests were made concerning the efficiency of this method, and also of longer retention with results as shown:—

Time	Without Compressed Air	With Compressed Air
Inlet	8.2 p.p.m.	8.2 p.p.m.
Pump	4.1 "	3.9 "
1 hr. retention	2.9 "	1.3 "
2 " "	2.7 "	0.9 "
4 " "	2.2 "	0.2 "
8 " "	1.3 "	0.2 "
24 " "	0.5 "	0.2 "

The blower was decidedly noisy to operate, and because its slight benefit to the water was not compensated by its operation cost, it was decided to discard it and substitute longer retention and better air circulation through sprays. Accordingly, the outer basin was built, giving one hour more retention and additional ports were cut in the wall at the spray end. Three months ago, 20 additional sprays were added, making a total of 50 nozzles on 3½-foot centers.

"What will we do with the gas now that we have taken it from the water?" is the question that is now confronting Beverly Hills. The neighborhood has been complaining about the odors that come from the plant. This photograph shows aeration plant and plainly illustrates the effect of H2S on trees in the foreground.



deLavaud Centrifugal Cast Iron Pipe

—is now ready to ship in sizes from 4″ to 20″

The principal features of deLavaud Centrifugal Pipe are:

1—Lower cost per foot.
2—Greater carrying capacity due to larger inside diameter. Its smooth surface produces less friction.
3—An even greater resistance to corrosion owing to its finer granular structure.
4—Cheaper to install owing to its uniform lead space and self centering bell.
5—It is easier to cut and tap.
6—Its greater strength and uniform section makes it valuable for use for higher pressures.
7—Adaptability to special joints due to its smooth exterior and uniform circumference.
8—It is made to be used with standard fittings and specials.
9—Annealing gives a uniform metal with no casting strains.
10—This method of casting leaves no possibility for sand holes or gas pockets.

Write for special literature covering manufacturing conditions and specifications of deLavaud Centrifugal Pipe.

United States Cast Iron Pipe and Foundry Company

General Offices:
Burlington, New Jersey

SALES OFFICES

Philadelphia: 1421 Chestnut St.
Chicago: 122 So. Michigan Blvd.
Birmingham: 1st Ave. & 20th St.
Buffalo: 975 East Ferry Street
Cleveland: 1150 East 26th Street
New York: 71 Broadway
San Francisco: 3rd & Market Sts.
Pittsburgh: 6th & Smithfield Sts.
Dallas: Akard & Commerce Sts.
Kansas City: 13th & Locust Sts.
Minneapolis: 6th St. & Hennepin Ave.

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ITS NOT in the HEAD ITS IN THE PUMP!!!

Mister Dealer

Mister Pump User

Here is news! Interesting news! For both of you.

Smallest Diameter Five Inches — Minimum Capacity Fifty Gallons Per Minute

EACH SIX FOOT UNIT A PUMP IN ITSELF

Satisfaction assured to both the Seller and the Buyer. The Kimball story is complete—read it!

ADAPTABILITY. Large capacity from small well.

LOW PRESSURES. The spacing of the impellers reduces the pressure to less than three pounds at any part.

STRAIGHT WATER COURSE. Water is raised in a straight upward course.

EXTENDABILITY. All extensions made from the top. Each six-foot section a complete pump.

STRAIN DISTRIBUTION. Direct flow allows spacing of impellers evenly throughout the shaft.

WIDER RANGE. Semi-displacement permits a wider range of speed and capacity.

REPAIRS EASILY MADE. All parts interchangeable. Don't return the Kimball to the factory.

GASSY WELLS. Gas and air bubbles are raised with the water — no pockets to collect either.

CAPACITY. Greater from a given size well with unusually slow rotative speeds.

POSITIVE LUBRICATION. Lubricated with soft grease from the inside under high pressure, through hollow shaft.

LONG LIFE. Only the best of materials, combined with skilled engineering practices, go into Kimball Pumps.

SEND ME YOUR CATALOG NO. 103.

Diameter of well.....inches
Depth of well.....feet
Distance to water.....feet
Will lower down when pumping to.....feet
Lift above surface.....feet
Would like a capacity of.....gallons

NAME.....

ADDRESS.....

FRANK J. KIMBALL CO.
1857 E. 15th St. Los Angeles, Calif.

Interference of sprays is now excellent and the elimination of H2S from water thoroughly satisfactory. Except when pumping into outer basin while cleaning inner basin, in which case water does not pass through sprays and receives practically no aeration, no trouble is caused from H2S or, "black water."

The black water is, of course, caused by the H2S attacking the iron of the pipe with the formation of iron sulphide, which is easily detached and carried into the system. This is readily corrected by a thorough flushing of the mains in the district in which it occurs.

RAY L. DERBY

Recent tests show that, with five second feet passing through the plant, and but two hours retention, the H2S is reduced from 8.4 p.p.m. at the inlet, to 1.3 p.p.m. at the pump discharge. This amount is below that which can be normally detected by taste and is also about the limit of reliable chemical detection. Many reducing agents present in the water may act upon the solutions used and cause erroneous results.

It is felt, therefore, that as far as the elimination of H2S from water is concerned, this has been accomplished to a satisfactory degree.

From the very first operation of the plant, the odor of H2S has been pronounced in the vicinity. Aside from laboratory tests and studies being carried on, no very definite steps were taken toward the elimination of this nuisance until recently, for the plant was enjoying relative isolation for the first two years. It was possible at times, especially during the rainy season, to get along with the Willows Wells or only one or two of the lesser H2S producers.

The air escaping from the three stacks was analyzed and found to contain 3.9 p.p.m. of H2S. On the basis of 37,500 cubic feet per minute delivered by the three fans, and 24-hour operation, about 170 pounds of H2S is eliminated per day.

Various methods have been considered or tried for the elimination of H2S from the air as follows:—

1. *Ozone.* This was tried out on both the air and water and, while successful, would be excessively high in installation and operation costs.

2. *Chlorine.* The Henderson-Haggard process of odor elimination by use of Chlorine was considered, and while their representative was willing to guarantee satisfactory results with this method, it was not given a trial except possibly as a last resort. Since two parts of Cl combine with one of H2S it will require at least 350 pounds of Cl per day or, at 12 cents per pound, an operation charge of $42 per day. Hydrochloric acid may also be formed, which will be objectionable.

3. *Burning.* Burning has been tried out and found to be successful to a certain point. Two objections to this method are that successful burning requires less draft than is believed necessary for satisfactory aeration of water, and close regulation of combustion needed. If complete combustion is obtained, the H2S is converted to SO2, which, though perhaps less objectionable than the former to the sense of smell, is much more destructive to property.

Burning Presents Difficulties

The advantages are that the heated air will rise higher and probably be dissipated more. If properly regulated, the SO2 that is formed will combine with H2S still present, to form free sulfur and water, neither of which are objectionable. The cost of burning will be about five to seven dollars per day.

4. *Sulfur Dioxide.* Experiments are being carried on at present with the use of SO2. Crude sulfur is burned between the sprays and the fans. The period of contact is about one minute which does not appear to be entirely sufficient for complete reaction. At the top of the stacks, the odors of H2S and SO2 are both distinguishable. Some distance from the plant an odor like neither of these two gases is noticed, but of a rather musty character. This is so faint, however, that it is not highly objectionable, as compared to H2S alone.

Some difficulty is being experienced with getting a thorough mixing of the two gases before leaving the stacks. It is believed, however, that this will shortly be overcome. This method appears to be one of the cheapest and simplest so far considered. About 160 to 170

For Detailed Listings, Branch Offices, Etc., See the Buyers' Guide to Leading Supply Sources—Pages 55-56

pounds of sulfur are used per day, at a cost of $30 per ton. What effect the SO2 fumes will have on the metal within the building remains to be determined. Provided a complete reaction occurs, their effect should be nil.

ABSORPTION MAY BE USED

5. *Absorption.* Various alkalies such as soda ash, lime, caustic soda,etc., will readily react with H2S. By passing the gas through an absorption tower with one of these alkalies present in solution, the H2S will be taken in solution and eliminated from the air. This method has not as yet been tried, as it was thought best to try more simplified methods first. In event that others fail, it will undoubtedly be used as a last resort.

The writer would be glad to hear from anyone having had experience in any similar problem, and will welcome any suggestions.

The various tests and experiments on both the water and the air were carried on under the direction of the writer in collaboration with F. S. Moon, Jr., of the Western Precipitation Company.

How the Big Dam Was Built

(*Continued from Page 15*)

"Consider also that an average height-limit Los Angeles office building, with its twelve or thirteen stories, will often include in its construction about 5000 cubic yards of concrete. Compare this with the Exchequer dam, in which that amount of concrete was sometimes poured in two days' time, and where the total pourings for the structure amounted to 374,000 cubic yards. The concrete in the dam, on this basis, would provide material for a city of seventy-five average sized office buildings.

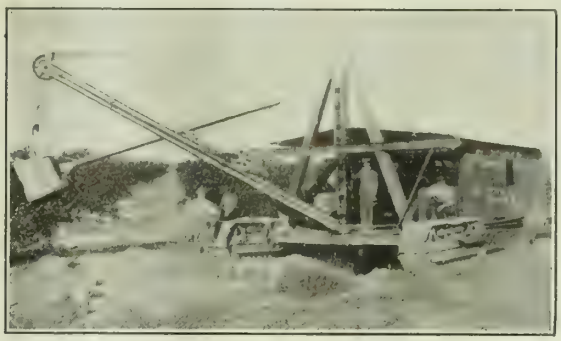
"Our best records in pouring this concrete will, I think, rank with any yet made on any comparable job. In the first twelve months after signing the contract, we poured 225,000 cubic yards. We made a maximum monthly total of 50,000 cubic yards, and our highest daily record was 2000 cubic yards. In reporting these marks through a national magazine, we invited a comparison of records, and only two efforts were made to challenge our championship in point of daily and monthly maximum."

In concluding his remarks, Mr. Bent paid high tribute to the ability and efficiency of the engineers of the district—R. V. Meikle, A. J. Wiley and Ross White—and spoke in cordial appreciation of the work of his own lieutenants, the men who have stayed on the job and seen it through, especially L. T. Grider, general superintendent and M. H. Slocum, job superintendent.

For Cleanout -- Maintenance -- New Ditches

There's a Bay City for Every Job

BAY CITY Land Dredges span the ditch, can dig any desired slope, and dump waste on both banks. BAY CITIES leave clean, wide berms, and can work up or down streams. One trip over the ditch is enough. The Shovel Type Dipper handles hard material in which other types of buckets cannot make a good showing.



At left—One yard BAY CITY Dredge digging and cleaning ditches in Florida Citrus Groves.

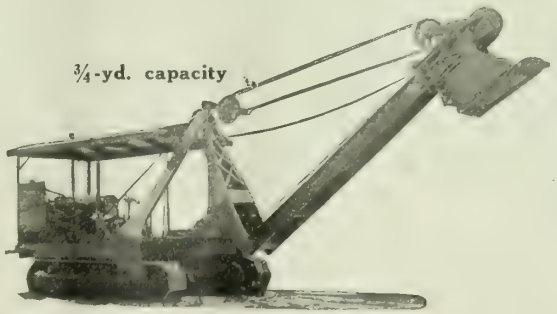
BAY CITY Land Dipper Dredges are built to fit the job. Walking, Crawler, Track or Floating mounting. Easily dismantled, transported and assembled. Capacities ½ to 1½ cubic yards. Oil engine or electric operation.

FOR SMALLER DITCHES — OR PIPE LINE TRENCHES

The BAY CITY 16-B convertible Excavator will handle a wide range of work. Operates Dragline, Trench Shovel, Clamshell or Skimmer. All steel. Shipped assembled. Digs any width or depth up to 20 feet.

STEEL CONSTRUCTION

¾-yd. capacity

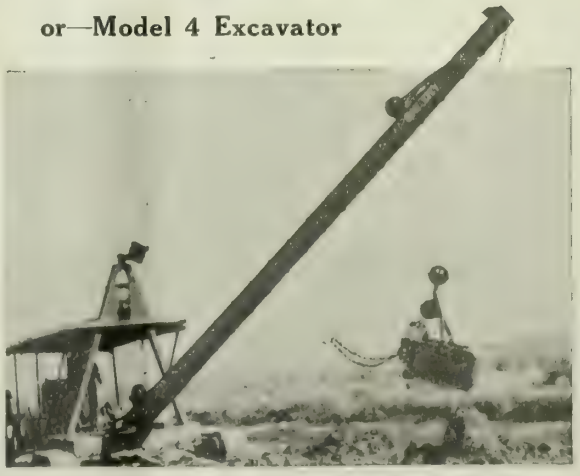


FULL CRAWLER MOUNTING

or—Model 4 Excavator

BAY CITY Model 4 is a small low-priced convertible, one-man operated Excavator. Fills the gap between hand labor and high priced equipment. Capacity 20 to 40 cubic yards per hour. Gasoline or electric power. A Real Digger economically designed for the small job. Also operates shovel, and clamshell.

WRITE FOR NEW CATALOG



One of the Model 4's Owned by Colorado Irrigation Companies. Cleaning Out Canal.

Our many years experience in manufacturing and operating Dredging machinery is at your service. Write us about your problem.

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San Francisco Representative: J. P. Sherbesman, 560 Geary St.

Denver Representative: H. W. Moore Equipment Co.

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TRADE NOTES *of the* MONTH

Water-Works and Irrigation Men Welcome Pipe Clamp

The Philbrook Spring Pipe Clamp Company, Los Angeles, is fortunate in having developed a product which fills a genuine need shared equally by the irrigation and water works industries, if the continued cordial reception which is being accorded the spring pipe clamp of that company's manufacture may be made the basis for judgment. Large companies in all parts of the west are adopting the Philbrook clamp after investigating its usefulness. Among California users of the product are such representative companies as the California-Oregon Power Company, San Francisco San Joaquin Light and Power Company, Fresno; City of Riverside, City of Redlands, City of Los Angeles; North Corona Development Company, Norco; Lake Hemet Land & Water Company, Hemet; Lindsay-Strathmore Irrigation District, and other power, land and irrigation projects.

The particular advantage to which the Philbrook company ascribes the increasing popularity of its clamp is its patented feature which permits of its adjustment around the pipe practically instantaneously, without handling two or more detached parts of the device, as is usually necessary in such appliances. The Philbrook clamp is a unit, which is clamped quickly round the pipe and tightened in an instant. It differs from other types of clamps also in that it is flexible, conforms to the contour of the pipe instead of lying tangent to its surface, and provides the highest pressure where it is neeeded, at the point of the leak. It is made in all sizes from two to twenty-four inches in diameter.

Armco Celebrates Anniversary of Corrugated Culvert

This year the 30th anniversary of the invention of the corrugated culvert is being celebrated by the Armco Culvert & Flume Manufacturers Association. The celebration was initiated by an exchange of telegrams between Walter H. O'Neall, president of the Association, and George M. Verity, president of the American Rolling Mill Company, in which Mr. Verity said:: "It is a significant fact that though the corrugated culvert is thirty years old Watson's original design has remained unchanged and is daily acquiring a host of new friends."

A feature of the celebration is the display in the Association's research laboratory at Middletown, Ohio, of the first corrugated culvert ever made. This culvert was manufactured by the inventor, James H. Watson, and placed early in 1896 under a public highway near Crawfordsville, Indiana, from which location it was recently removed for exhibition purposes. It is one of many similar culverts still in service near Crawfordsville.

Increased Water Activity Reported by Pomona Co.

Indicating extensive development of new water supplies by various irrigation companies, the Pomona Manufacturing Company, of Pomona (Calif.), has reported the recent installation of several large plants.

The Del Monte Irrigation Company has just begun operation of a new plant, producing 630 gallons of water per minute at a 200 foot lift with a 44-horsepower motor. This is one of the largest installations near Pomona.

Another large installation was completed for the San Dimas Water Company at San Dimas, California, producing 540 gallons per minute with a lift of 340 feet, using 70 horsepower motor.

Another large insstallation was completed for the Oak Water Company at Charter Oak, California. This plant produces 450 gallons per minute from 400 feet.

Other interesting California installations completed by the Pomona firm include those for:

The Italian Vineyard Company at Guasti, 1350 gallons per minute; the Monte Vista Irrigation Company at Ontario, 1150 gallons per minute; the Tustin Water Works at Tustin, 630 gallons per minute; the Cutler-Lobinger Packing Company at Ontario, 90 miner's inches from a lift of 180 feet; the City Water Company at Visalia, 450 gallons per minute; and a very fine plant for A. Carricaburu at Riverside, 630 gallons per minute.

Sterling Pump Chief Reveals Results of Recent Test

Results of a recent test by the San Joaquin Light & Power Company, Fresno, have been made by the Sterling Pump Works, the manufacturers of the pump which was used in the experiment. A statement by J. E. Lundy, general manager of the Sterling works, say:

"We have been greatly gratified to learn of the results of this interesting test. A Sterling pump in the Bakersfield territory delivered 1100 gallons per minute; pump head 65 feet; horsepower input to motor 28.95; overall plant efficiency 63 per cent. This represents a cost per acre-foot of .92188; cost per 24 hours of operation, $4.51."

Mr. Lundy declares that much of the credit for this high type of performance may be given to the experimental department of the Sterling organization, which devotes much time and expense to developing pumps of high efficiency.

He incidentally points out that production and sales records of the company are being broken by the current demand for pumps, and that the present season is the busiest one in its history. Two shifts of men are kept busy turning out pumps to fill orders coming in from all parts of the west, Mexico and a number of far eastern points.

Visits Armstrong Factory at Waterloo, Iowa

Harry C. Kaufman, president of the Kaufman Company, Los Angeles, distributors of Armstrong drilling machinery, has recently returned from a sixty-day trip to the Armstrong factory at Waterloo, Iowa, and other points in the midwest and northwest, making a study of well-drilling conditions in the various irrigated sections through which he passed.

Mr. Kaufman reports that the Armstrong organization is enthusiastic over both the current and prospective business in the Pacific Coast territory, and that there is a growing demand visible throughout the irrigation country for equipment of this manufacture. One of the reasons for the keen interest in Armstrong equipment among well-drill-

ers, according to Mr. Kaufman, is its exclusive patented feature which permits of the use of a wire-line in the derrick instead of a manila line.

Bottom-Dump Pull-Shovel Introduced to Trade

The Northwest Engineering Company have recently added a new trench pull shovel to their line. This machine is in general principle similar to the standard Northwest Pull-Shovel first put on the market in 1925, but is different, in that it is equipped with a bottom-dump bucket instead of the scoop type used on the other model.

The bucket is hinged back of the teeth. This allows the bottom to drop out when a bolt is pulled by the cord in the operator's hand. When the bucket is returned to the ditch in the process of digging it automatically closes on striking the bottom of the cut and the bolt holds it in place.

Buckets are supplied in two sizes for each of the Northwest models; 33 inches and 39 inches wide on the Model 105, and 42 inches and 48 inches on the Model 104.

This machine is, like all Northwests, equipped with the "feathertouch" clutch control, and the exclusive Northwest patented steering device which allows full traction while turning as well as going straight ahead.

Western Product Enters Into World-Wide Trade

A western product which is rapidly expanding its market to embrace the world-wide field is "Laykold" the bituminous material manufactured by the Crown Bitumens Corporation of San Francisco for canal lining, street paving, etc. Laykold is now being exported to Australia, New Zealand, the Hawaiin Islands, Canada, Ecuador, various other points in South America, and Johannesburg, South Africa. Experiments in varied uses of the product are being carried on at the present time in points as remote as Germiston, South Africa and Wellington, New Zealand.

Sells Big Order in Texas

L. C. Fay, a sales engineer for the Byron-Jackson Pump Manufacturing Company, has just returned from Fort Hancock, Texas, where he has been for the past month. The trip took him to the mid-continent section and throughout Texas in the interests of his company. It resulted in the signing of contracts for the sale of forty deep-well turbines to the Hudspeth County Conservation and Reclamation District Number One, a Texas district which is undertaking some very active developments.

The Vital Link

between the two Main Tunnels of the Hetch Hetchy Water Project, is the "South Fork Crossing," an exposed pipe aqueduct. It is coated inside and outside with

Biturine

"The corrosion preventive" with a 20-year record

The vital importance of this pipe line naturally called for a Corrosion Preventive of undisputed dependability.

Our Modern Handbook "Pipe Protection" is yours for the asking. Write for it. Contains comprehensive specifications.

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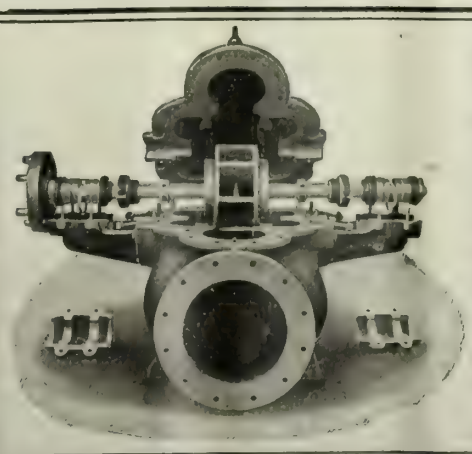
Seattle *Portland* *Baltimore* *New York*

"Dependable as a lighthouse"



PRICE PUMPS

We specialize in Centrifugal and Deep Well Turbine Pumps for Irrigation and Industrial Uses—
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High in Efficiency.
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And Low in Upkeep Costs.
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IRRIGATION FINANCE

How Can the Government Promote the Prosperity of the Country

By C. E. GRUNSKY*

WHEN the price of wheat was fixed during the war, the indirect effect was to raise the market value of farming land. The promoters of the scheme to stimulate the production of food may not have had this prospective effect in mind, but the fact is that much mischief has resulted, from which certain sections of the country have not yet fully recovered.

So, too, when under the provisions of the United States Reclamation Act passed in 1902, the farmer home builder was covertly offered a bonus in the shape of a waiver of the interest charge on funds advanced by the Government for the construction of irrigation works, an attendant result, though hardly anticipated by the framers of the measure, was to add an undeserved increment to land values.

The settler on the irrigated farm thus indirectly received a bonus. He may not have been aware of this circumstance, but the bonus was none the less real, and was sooner or later apparent in the sales value of the irrigated tract. Not only this, but in some cases even the possibility that the government would be lenient and would not demand full return of operating costs, was capitalized.

It is probably safe to say that if the landowners in Government reclamation projects had financed these projects themselves the cost per acre of providing the irrigation works would have been nearly doubled. The 40 to 50 per cent of the cost, which the no-interest provision saved the landowner, is the subsidy which went to the first comer or original owner.

But in the case of every such subsidy or bonus accruing to the farmer, the advantage, if fully realized, stops with the first owner. It cannot be passed on indefinitely, because the capital value, which an assured income, for example,

C. E. GRUNSKY

would create, will never intentionally be passed on as a bonus to a subsequent owner. It follows, therefore, that all schemes to aid the farmer by fixing prices or by guaranteeing the marketing of farm products must fail. It will in such cases be but a few years before the farming business, as the result of unnatural stimulation, will be as badly off as it would have been without the aid of a bonus.

After the foreign market fails to take at a fair price the surplus production of a big country such as ours there is only one way to keep it continuously prosperous. The balance between production and consumption must be studied and carefully preserved. A relatively large group of consumers at home must be created and maintained.

Public works on a large scale, buildings, roads, canals, harbors, public parks, museums, sea coast and mountain places of recreation, schools and other educational institutions should be fostered and endowments encouraged, libraries, art galleries, operas and theatres, and means of inter-communication should be provided far beyond this country's past or present program, preparations for defense, on land, at sea and in the air, should be made without stint as to cost, because the soldier and sailor is for the time being removed from the producing class and made a consumer. This during any period of over production can only make for prosperity, because funds expended for such purposes go into circulation at home and help to swell and stabilize the volume of the country's business. Research work on a grand scale,—social, economic and particularly scientific, should be undertaken, and, furthermore, the middleman should not be run entirely out of business.

A declaration of such a principle, making as it must for relatively high, not relatively low taxation, may not be popular, but when the taxation is equitable and the burden does not fall disproportionately on any class, ability to pay taxes being taken into account, and when the country is assured that there is fair efficiency in government administration—that every dollar expended will produce a dollar's worth of result—then, perhaps acceptance of such a program could be hoped for. It would assure general and lasting prosperity which occasional financial panics and the like could not seriously disturb and in which the farmer would have his proportionate share.

If, however, despite the transient nature of aid to the farmer, he is to be assisted in making his crops profitable,

*NOTE—Mr. Grunsky's interesting comments on the farm problem and some of the possible means of promoting agricultural prosperity will be read with interest because of the prominent position which the author holds in the engineering profession. Possibly not every reader will agree with his conclusions. The editor ventures to make some comment upon his thesis on the editorial page of this issue.—EDITOR.

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THE completion of the Exchequer Dam is another monument to the progressive spirit of Western Irrigation Engineers. Laykold is also a western product and is progressing with Irrigation Engineering. Perfect asphaltic concrete ditch linings are now constructed with this handy product without the use of heat or expensive equipment. When used as a paint to prevent water losses, the results are more than satisfactory.

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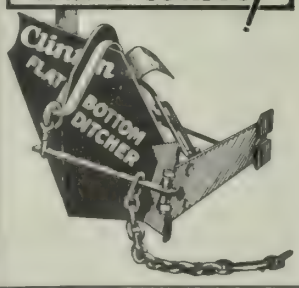

Here are— 5 Advantages:

you'll appreciate in this tool:

1. It builds a ditch which carries more water than a "V" ditch, depth and fall being equal.
2. The "off" horse walks on the flat ditch bottom instead of on the slope.
3. Silt fills this type of ditch more slowly and there is less overflow.
4. Erosion is minimized in the flat bottom ditch.
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the extended aid should not be of a character that will encourage his activities as a speculator but rather in such form that it will expedite the movement of the crop to the great centers of distribution.

The simplest method of accomplishing this will probably be found to be by reducing the cost to the producer of transporting the farm products to a market. This can readily be accomplished by granting a rebate payable by the Government on rail and water transportation charges. Such a rebate should be proportional to the freight bills and should be so fixed as to assure movement of the crops; but in no event at more than some specified limit such as one-third or one-half. A single scale of rebates should apply to the whole country with a possible departure from this rate only in case of shipments to foreign countries. For economic reasons it is of prime importance that a fair exportable surplus be marketed abroad. This will aid in maintaining a favorable balance of trade, as well as in maintaining farm activities.

Not a Permanent Cure

No such freight rebate system nor any other form of bonus to the farmer will keep him permanently above water. It will, however, contribute to general prosperity. It will help temporarily the remote agricultural and horticultural sections of the country.

It will be equivalent to giving a bonus to the present owners of farming lands —varying according to location and character of the crops. It will indirectly be of some permanent benefit to the farmer along with the advantages that it will bring to transportation lines and to every other type of business in the country.

It will benefit the farmer who sells at home in the full measure that it benefits the farmer who sells his product to a remote market, because the reduction of freight rates will immediately add value to the farms' output regardless of whether it is shipped or consumed near home. However, as already stated, it will not effect a permanent cure of the farmer's troubles. He will, thereafter, as in the past, have to contend with all the factors that have heretofore worried him and will find that, at intervals of about 20 years,† he will be hard hit by general business depressions unless, indeed, such a program of artificially swelling the consumer class as above indicated be made the policy of the nation. The relatively high taxes inherent in such a policy need not be

†Note: = 1817, 1837, 1857, 1893 to 1898.

feared. They will be collected only from those who are able to pay and who, in their turn, will share in the engendered general prosperity.

It will no doubt be suggested by those who are timid in such matters, that funds expended for an army and a navy, or for monuments and the like, are wasted, but would be conserved if expended in the production of some marketable output.

The answer is that even the funds thus expended go into circulation. The battleship that costs $10,000,000 provides the opportunity of taking this sum from those who have a surplus and putting it into circulation—through the laboring man and thereafter it keeps on moving. For each million thereof expended in some locality, it is probably safe to say, some $12,000,000 worth of business will result in the following 12 months. Even if it be argued that the first expenditure might have been for something more useful than the creation of the battleship, this criticism will not apply to the repeated transfer of the expended sums among the trades people and business men generally. The released million will escape from the local community but slowly, if at all. It will have its effect upon local business and local prosperity much longer than the twelve year period here used for the purpose of illustration.

Similarly, if aid be now extended to the farmer, even though it merely result in giving the present landowners a bonus, the transient stimulant will get many a crop into market which would otherwise not be grown or would be allowed to rot in or on the ground. And wherever this is the case the local community will benefit in business many times the value of the marketed crop, even as it does when it holds in its population an army of professors, or research men or even plain ordinary soldiers.

Philadelphia Exposition Includes Irrigation Exhibit

A model of a 40-acre irrigated farm, showing water running in the canal, laterals and farm ditches, with farmhouse, barns and other outbuildings in minature and with various plots of ground in different irrigated crops, is a feature of the Sesquicentennial Exposition being held in Philadeplhia. The model farm is a part of an exhibit showing the activities of the Department of the Interior. In addition to this feature, irrigation is represented in the government's display by colored photograhps of many representative scenes on the federal irrigation projects, such as famous dams built under government direction.

You *Name the* Load
We *Make the* Pipe!

SINCE concrete pipe (as made by Bent) came into its own, engineers question no longer its striking advantages for a great variety of uses. *But*—a concrete pipe installation is either a mediocre or an eminently superior job of work, depending upon who fulfilled the contract.

Many trade names have become hall-marks of tradition, that serve as an unerring guide to discriminating buyers. Today the name "BENT" on a joint of Concrete Pipe marks it as a strictly finely made product. The same care and skill is exercised in its manufacture, and in the laying of the line, as though every future contract depended on *that* job meeting the fullest requirements of specifications—*and more.*

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WHO'S *WHO* AND WHO'S *WHERE*

IN THE WORLD OF HYDRAULICS

Personal Notes and Impersonal Observations About Men You Know

A. L. Hobson, former director of the Palo Verde (Calif.) Irrigation District has resigned his position to take effect immediately. Mr. Hobson's reasons for his resignation were not given in dispatches to the press.

Louis Borneo, president of the Republic of Haiti, who was an official visitor in the United States during June, expressed the keen interest in irrigation and reclamations problems which is felt in his country when he made a feature of his visit a conference with Secretary Work and Commissioner Mead on the work of the American government in reclamation.

Bernable Flores, who for the past five and one-half years has been the chief clerk of the Imperial Irrigation District (Calif.) with offices in Mexicali, California, recently announced that he had resigned his position to take effect immediately. Mr. Flores served for six years as secretary of the El Paso Water Users' Association (Tex.) previous to his going to California.

James E. Baker, of Los Angeles, California, has been selected by the Baldwin Park (Calif.), County Water Board as engineer to have charge of the installation of a water plant in the recently organized district. Mr. Baker was engineer for the Board of Public Utilities of Los Angeles for a number of years previous to his appointment to Baldwin Park.

Governor Hannett, of New Mexico, has appointed a conference committee to confer with representatives of Arizona with reference to division of water of the Gila River. Charles Fuller and L. P. McHaffley of Lordsburg, (N. M.), James Harper of Redrock, (N. M.) and J. B. Beavers and H. G. Alberts of Duncan (Ariz.), are the men that have been appointed on this committee. An agreement between the states is deemed advisable, it is said, in view of the plans to dam the Gila and San Francisco rivers at New Mexican points for the benefit of irrigated farms that lie in Arizona.

A. E. HITCHNER

With the resignation of K. E. Van Kuran, former head of the Westinghouse Electric and Manufacturing Company's activities in the Pacific southwest, comes the announcement that A. E. Hitchner will succeed him. Mr. Hitchner obtained his degree in electrical engineering from Rutgers College in 1904, and he entered the apprentice course for college graduates at the Baldwin Locomotive Works in Philadelphia. After two years training there he was employed by the Link Belt Company, remaining until 1906. After a year's mining operations with the Kaolin mines in Florida, he joined the forces of the Westinghouse Company, and was assigned to general industrial sales work in the Philadelphia office. In 1912 he was placed in charge of anthracite mining sales for the company. From 1919 until his present transfer, he was assistant manager of the industrial department. Mr. Van Kuran, after a long and successful experience as a Westinghouse executive, has resigned to become connected with corporate interests in Los Angeles.

The report of Resident Engineer Harry Barnes, the San Joaquin River Water Storage district (Calif.) to the valuation committee of the district's board of directors will be made and discussed between July 15 and July 30. It is hoped by officials of the district that a solution may be found, based on this report, for the many storage problems facing them at the present time.

Mayor C. E. B. Oldham and Commissioner C. S. Halverson, of Bremerton, Washington, recently made a visit to the Zimmerman ranch near Bremerton on an inspection tour. The city of Bremerton is seriously considering the purchase of the Zimmerman ranch to protect its watershed and to prevent the pollution of the domestic supply of wa-

---

C. C. Teague, president of the California Walnut Growers Association, recently visited Oxnard, California, to attend a meeting sponsored by the Oxnard Chamber of Commerce. He discussed the question of water supply, especially as affecting land owners of the Oxnard district. "We always believed that we had all the water we needed," he said, "but the last six or seven short years have dispelled this view considerably. Dry farming is now considered hazardous, and water for irrigation is absolutely needed."

Dr. Elwood Mead, Commissioner of Reclamation, is in the West on an extended tour of federal reclamation projects. He left Washington June 17, and will return July 21, in the meantime dividing a very full month between various duties connected with the business of reclamation. He appeared late in June on the program of the American Society of Agricultural Engineers meeting at Lake Tahoe, and will visit a number of northwestern projects during July. He will be accompanied by Maurice G. Ricker, photographer, who will make a record of activities on the projects in still and motion-picture films. The Orland Project (Calif.), the Okanogan project (Wash.), and the Yakima project in the same state will be included on the itinerary.

The Story of Exchequer

(*Continued from Page 13*)

obtained from a bar in the Merced River 18 miles below the dam. By careful grading and the use of cobbles in the concrete mix, mass concrete in the dam and spillways averaged only 0.822 barrels of cement to the yard, which includes the cement used for grouting and for the richer mix used in the faces of the dam.

Test cylinders six inches by nine inches showed a strength of 1600 pounds per square inch in twenty-eight days, while cylinders eight inches by twelve inches gave a strength one and one-fourth times as great. The average mass concrete batch was seven sacks of cement, 24.7 cubic feet of sand, 15.7 cubic feet of fine gravel, ¼ inch to 1 inch, 17.3 cubic feet of coarse gravel 1 inch to 2½ inches and 34.8 cubic feet of cobbles 2½ inches to 10 inches; and produced 62 cubic feet of concrete.

Cobbles were not used in bridge pier concrete, which averaged 1.28 barrels of cement per yard, and tested 2500 pounds per square inch; or in tunnel lining which averaged 1.16 barrels of cement per yard and tested 1800 pounds per square inch.

Bids for the construction of the dam, power house and railroad were received by the district May 31, 1924, but due to delay in financing, actual work was not started by the contractors until September, the contract having been signed in August. The total construction time required to build the project and put it in operation was twenty-one months. The total expenditures on the Exchequer Project amounted to $10,800,000, of which approximately $10,000,000 was spent on construction work. The relocation of the Yosemite Valley Railroad cost more than the Exchequer Dam and Power House combined.

A contract between the District and the San Joaquin Light and Power Corporation provides for the sale of the total output from the power plant over a period of twenty years, the District having the option of renewing the contract for another twenty-year period. The average net income from the sale of power is estimated at $470,000 yearly. This co-operation on the part of the power company may be said to have made the building of the project possible at this time.

Storage water to insure a full irrigation supply is essential to the development of the Merced Irrigation District. While irrigation near Merced dates back to 1883, only 40,000 acres were irrigated in 1919 at the time the District was organized. This year 102,698 acres are being irrigated by gravity and 13,500 acres by pumping.

CLEARFLOW

INCLINED SEAT CHECK VALVES

BUTTERFLY VALVES

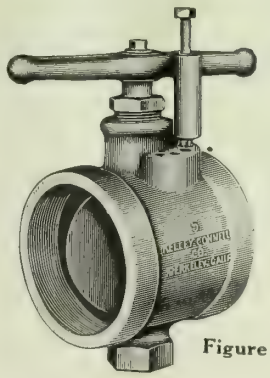


Figure 20

Butterfly Valves

Flanged and Screwed

Regular and Side-Outlet.

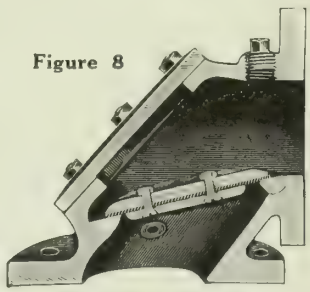
Bronze gates and moving parts.

Close-fitting and well-finished.

Elbow Check Valves

Silent
Reliable
Less head loss
More compact
Easier access to pump

Figure 8



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LEGAL *and* JUDICIAL

A DEPARTMENT CONDUCTED BY HANKINS & HANKINS

Defective Applications Must be Heard

Division of Water Rights is required to hear applications although they may be defective in form.

An application was made to the Division of Water Rights of the State of California for a permit to appropriate water for municipal uses. The Division considered the form of the application to be too uncertain and refused to hear the matter. The plaintiff brings an action in mandamus requiring the Division to proceed to hear and act upon plaintiff's application. The trial court granted the writ and an appeal is taken to the Appellate Court and by that court determined in the action of Rich vs. W. F. McClure, etc. et al, 50 Cal. App. Dec. 311 (May 29, 1926).

The appellants claimed that the application was defective in that it did not set forth the intended place of use, the method of transportation or a sufficient map showing the details of the plan.

The Appellate Court states that the cities named in the application being incorporated cities, the courts will take judicial notice of the boundaries of such cities and therefore the place of intended use is sufficiently set forth. It further stated that under the liberal provisions of section 1a of the Water Commission Act a hearing may be held and a permit granted even though the application therefor be defective. Also the application may be granted in part and denied in part.

Appellants urge that plaintiff was not entitled to a writ of mandate because he had a plain, speedy and adequate remedy under the provisions of section 1b of the Act by a hearing in the Superior Court. The Appellate Court points out, however, that this applies only after a hearing has been had and a permit either granted or denied and not where a hearing has been refused.

Prescriptive Rights and Irrigation Districts

A prescriptive right to water may be acquired against an irrigation district.

In a contest between water users of Big Rock Creek in Los Angeles County, California, it was contended that a private water user could not obtain a water right by prescription as against the Big Rock Irrigation District.

This district had been formed under the so called "Wright Act" and for a number of years had used the water of the creek for the lands of the District. Disaster overtook the territory by reason of draught and the district did not function from 1900 to 1914. In the meantime private persons had appropriated all the water. The Big Rock Mutual Water Co. is the successor in interest of the water rights of the District.

In the case of Big Rock Mutual Water Co. vs. Valyermo Ranch Company, 50 Cal. App. Dec. 346 (June 2, 1926) the Appellate Court held: " . . . there can be no question that where public lands have been devoted to a public use, persons cannot obtain title thereto by prescription founded on an adverse occupancy. This principle is indisputable and is not here disputed. It has no application, however, to the instant case. The title or interest that one may acquire in the waters of a stream is entirely different to that which may be acquired in land. Running water, so long as it continues to flow in its natural course, is not and cannot be the subject of a private ownership. A right may be acquired to its use, but this right carries with it no specific property in the corpus of the water itself . . . This interest is dependent upon user and it may be lost when the owner ceases to make avail of the same. . . . This rule has been applied against a public service corporation and there is no reason in principle why it should not equally apply against an irrigation district."

Appropriation of Underground Waters

Waters of an underground flowing stream are as available to appropriation as waters of surface streams.

In the case of Pima Farms Co. v. Proctor, 245 Pac. 369, (April 19, 1926) the Supreme Court of Arizona sets forth the rules governing the appropriation of underground waters. It was conceded in the case that the body of water in controversy was a known independent subterranean stream.

The Supreme Court states: "It is, and has ever been, the policy of this State to make the largest possible use of the comparatively limited quanity of water within its boundaries. In order to do that, it is obvious that some other rule than the riparian doctrine should be the standard adopted. Accordingly, the territory at an early date, and the state upon its organization, abrogated the common law rule of riparian rights as unsuitable to our conditions, and, in accord with most of the western arid states, adopted the doctrine of prior appropriation. Under this doctrine the waters of an underground flowing stream are equally as available to appropriation by the owners or possessors of arable or irrigable lands as the waters of a surface stream, and the appropriation is goverened by the same principles of law."

A further point of extreme interest is made by the Supreme Court where it holds that an appropriator's method of diversion is also entitled to the protection of the court. On this point the Court states: "It is true the means of appropriation are a secondary consideration, and may be changed by the appropriator from time to time if no injury results to others, or may be changed by direction of the courts in proper cases to enlarge the use of the waters of the stream; but the means are not inconsequential because without them the water right would be unavailable and worthless . . . In other words, the appropriator does get something more than a water right; he gets an easement in the bed of the stream and the underflow to support and carry his water so that it may be used and enjoyed, and while he does not appropriate or apply to beneficial use, as that term is understood, the underflow, and while such underflow may be appropriated, those who appropriate it must adopt means to preserve to the prior appropriator his rights without injury to him.

In quoting the case of Salt Lake v. Gardner, 114 Pac. 147 the Court adopts the language of that court as its views of the law, as follows: "Counsel for respondents, however, insist that the prior appropriator acquires no right in his means of diversion, but obtains a prior right only to use the quantity of water appropriated and applied to a beneficial use by him. We cannot yield assent to this view. We think the original taker or appropriator from a stream or body of water also acquires the right to continue to use his method or means of diverting which he has installed."

The Court also disinguishes the case of Schodde v. Twin Falls etc. 161 Fed. 43 wherein it was held that an appropriator of water, diverted by water wheels, was not entitled to claim the right to the continued use of the entire stream to run his wheels, where such additional water was claimed by other appropriators.

Damages from Water Lack, or Poor Husbandry?

Whether damages to an orchard were caused by lack of water or poor farmer is a question of fact to be determined by a trial court.

In the case of Hill et al v. Selah & Moxee Irrigation District, 245 Pac. Rep. 752 (Wash.) (May 5, 1926), the plaintiffs bring a suit against the irrigation district for damages for an alleged breach of a contract to supply them with water for irrigation purposes. The plaintiffs were the owners of 51 acres of land upon which they were entitled to water during the irrigation season, which, by the contract, was fixed as beginning April 1st and ending November 1st. On January 23, 1923, plaintiffs wrote the district notifying it that they were setting out considerable nursery stock and would need water early in the spring. The planting began on March 29th and was finished on April 5th. Water was turned into the ditch at the intake some two miles above plaintiff's property on April 2nd, but did not rise to sufficient height for plaintiffs to get water until approximately April 13.

Plaintiffs claim the damage to the orchard was through lack of water. The district claimed that the damage was not due to lack of water but due to the failure on the part of plaintiffs to exercise good husbandry, in packing, in caring for the grafts, in preparing the soil, and in planting and cultivating.

The trial court found "That the loss sustained by plaintiffs was not due to the lack of irrigation water." The Supreme Court of Washington held that the evidence being

conflicting, the judgment of the trial court would not be disturbed.

The Supreme Court further stated: "We are invited by the respondent district to construe the contract as not requiring the furnishing of water prior to the opening of the irrigation season where the water is desired for a specific purpose, without definite notice having been given . . . it seems best to us to leave the construction of the contract until that question is more nearly directly involved in the determination of a controversy."

Abandonment of Water Right

An intent to abandon a water right must be clearly shown.

In the case of St. Onge v. Blakely, et al., 245 Pac. 532, (March 19, 1926) the Supreme Court of Montana sets out the rule of law as to the abandonment of a water right. The question arose over a suit to determine conflicting water rights where a claim is made that a right had been lost through abandonment.

The Supreme Court says: "It is contended that the Suprenant and Marceau right was abandoned and lost by non-use between 1882 and 1896 . . . but the right was fully perfected prior to 1882 and thereupon became a property right of which the owner could only be divested in some legal manner. He could, thereafter, use the water or not, as he saw fit, or he could abandon the right, but abandonment is a voluntary act involving a concurrence of act and intent—the relinquishment of possession and the intent not to resume it for a beneficial use—neither alone is sufficient to bring about the abandonment of the right. Mere lapse of time, even in excess of the period prescribed in the Statute of Limitations, will not alone establish the abandonment of a water right or work a forfeiture thereof by non-user, although it may constitute some evidence of an intention to abandon the right"

Responsibility of Diking Districts

Neither a diking district nor its commissioners are liable for damages under the Washington statutes.

In the repairing of one of its dikes, Diking District No. 12 of Washington used certain dynamite and dynamite caps. During the absence of the workmen a nine-year-old boy took some of the caps and in playing with them some days later, they exploded, blinding and otherwise injuring him. The minor sues both the district and the commissioners, but on a demurrer to the complaint, the Supreme Court of Washington, held in the case of Shimada vs. Diking District No. 12, 245 Pacific Reporter 916 (May 12, 1926) that neither was liable.

In exonerating the commissioners the court says: "Their authority is to 'manage and conduct the business affairs of the district', and their acts in that behalf, when within the scope of their authority, are the acts of the corporation, not their individual acts, and they are not bound to answer personally, merely because of their official relation to the corporation, either for its contracts or for torts committed by its subordinate agents or employees . . ." No direct or personal negligence of the commissioners is alleged. The court then holds that the Diking District is a public corporation and is not liable to answer for the personal torts of its officers, agents, or employees, in the absence of a statute expressly declaring them so liable, and that there being no such statute in Washington, the district could not be held liable.

A TYPICAL LACY "JOB" IN THE IRRIGATION COUNTRY

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OVERHEAD IRRIGATION

CONDUCTED BY WM. J. B. STEWART

OVERHEAD IRRIGATION EMERGING INTO FULL STATURE

OVERHEAD IRRIGATION is just emerging from its early infancy, and it is, naturally, still characterized by the growing pains that accompany the rapid emergence of any new business But, through hard-taught experience, continual reorganizations and revision of conceptions, accompanied by mechanical improvements, the overhead irrigation 'game' has grown into an industry—one which may safely be said to have a great future and large potentialities.

Overhead can hardly be said to have followed a plan; like Topsy, it has "just growed." A foothill citrus grower nine years ago, with Mother Nature's precepts to follow, planted the seeds of the industry. He was followed by a valley gardener a year or so later, and three or four other growers in various parts of the country two or three years later. These pioneers installed overhead sprays or sprinklers, several without knowledge of prior installations having been attempted. Lawn and garden sprays and sprinklers, the only type known to those pioneers, mothered the early days of the industry. From this origin has come an expansion comparable only to the quick response of an under-nourished thirsty orchard after the installation of an overhead system.

Present Growth Meteoric

The greatest increase in installed acreage has come during the past year, and the last six months have seen twice as much progress in this direction as the preceeding six months. At the present time, overhead contractors are doing more work than ever before. There are more than 250 acres of new systems being installed, at this writing, as closely as can be checked.

The record grows obsolete while it is being set down, as regards the total acreage now under overhead irrigation, but there are more than 1200 acres under systems of various kinds. The types of systems, or of sprinkler heads characterizing them, are as varied as the crops to which the acreages are planted, although three fourths of the installations thus far are on citrus groves.

Overhead systems are in satisfactory operation on oranges, lemons, limes, avocados, walnuts, alfalfa, garden truck, sub-tropical trees and shrubs, home orchards of various deciduous varieties, commercial apples, field onions and beans, field flowers and and bulbs, general nursery stock, private rustic and formal estates and public parks.

Re-Introducing This Department

MODERN IRRIGATION is glad to have the opportunity of re-introducing this department, devoted to overhead irrigation, in this issue. It will be a regular feature of the magazine in the future, conducted by William J. B. Stewart, an overhead consultant of extensive experience and broad acquaintance in this specialized division of irrigation.

Mr. Stewart is frankly and sincerely an advocate of overhead irrigation and a believer in its advantages. In championing it so outspokenly he speaks his own conviction based on his experiences and observations. Not all of his ideas on all phases of overhead matters will necessarily be shared, in full, by the publishers of Modern Irrigation, but he will welcome, as will the magazine, full and frank discussion of all problems and questions related to overhead by intelligent observers regardless of whether their standpoint be the same as that of the conductor of the department.—Editor.

Of the several general types of sprinklers, classified roughly according to the coverage of the individual head, the smallest total acreage is served by sprays, with their shorter coverage. A considerably greater acreage is found equipped with the rapidly moving short-coverage sprinklers—these are mainly on older installations. Probably not so large an acreage is equipped with medium-coverage, medium-speed, single action or simple two-arm sprinklers; and, lastly, the great bulk of installations are equipped with wide-coverage sprinklers, necessarily of slow rotation.

The methods of accomplishing this slow rotation are the patented features of the respective sprinklers of this class. It may be accomplished by vibration or counter-action being used to interrupt the hydro-dynamic rotation of the main nozzle, as in the Orr compound and Climax Sprinklers, pioneers of this type. The Browning and the Skinner are prominent among the wide-coverage gear driven sprinklers, the former being used on orchard and the latter on golf courses.

Among the various types mentioned, in addition to those named above, the following are the most prominent to date—Thompson, Hadden, Rose, Buckner, Vacher, the new Lark, Rainmaker.

Results Evaluated

While there is a great diversity of opinion among growers and close students of overhead irrigation, with regard to its effect on various pests, diseases, frost, June drop, etc., there apparently exists a unanimity of opinion among scores of overhead irrigators as to the general satisfactory results attained from their systems. The one possible exception is hardly a blot on the record of practical overhead irrigation, as it is an every-tree spray mist installation on very heavy soil, which is hardly showing the improvement usually obtained by overhead installation.

Although the results from overhead have been generally gratifying, there were a considerable number of systems which were installed during the earlier days with a net-work of small pipe, or were "thrown in" by some of the contractors without due regard to the hydraulic requirements for the proper and continued operation of a system. These have been the cause of considerable dissatisfaction and dissension, but, fortunately, most of the errors were such as could be corrected, at least to an extent sufficient to make the systems workable.

To be fair, perhaps some of the dissatisfaction may be chargeable to an excessively "finicky" attitude on the part of a few growers with regard to the even distribution of water by the sprinkler heads utilized. While this is an important point, all of the leading sprinklers can easily be adjusted to distribute the water sufficiently evenly within the limits of the circle they can cover. Certainly, so long as the water is well over every tree, overhead irrigation seems to

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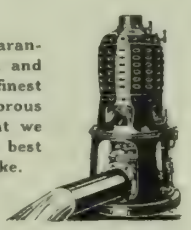

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this writer to offer a tremendous advance in the difficult manual art of evenly distributing water over land, particularly when the land is of irregular gradient or light texture.

So, without an outstanding guiding hand and beset by many conflicting opinions, overhead irrigation has developed in the past few years through the appeal of a better, easier, cheaper way of irrigation, holding forth the promise of better health and production for trees and other plantings.

Organizations Co-operate

Credit is gratefully ascribed to the farms bureaus and advisors, farm publications and growers who have recorded their experiences for the guidance of overhead irrigators. Through their efforts hundreds of prospective users are now figuring on the proper system design and requirements and on the financing of the installation.

It is with a keen appreciation of the need of a guiding hand for the industry, a fountain head for authoritative, practical and seasoned advice on the hydraulics and mechanics of overhead systems, an open forum for ideas pertinent to the subject, that this department has been established by Modern Irrigation for its readers. Articles by leaders in the overhead industry and its allied lines will be printed regularly. News items of interest and value to prospective overhead irrigators will be presented and questions on the subject will be discussed or answered by experts as explained in adjoining columns.

It is your department. Your interest and co-operation will make it more valuable to you.

Farm Advisors Lead Tour of Overhead Information Seekers

Seventy-five machines and more than 130 persons were guests of the Agricultural Extension Service on June 24, when the citrus growers department of the Farm Bureau and the county farm advisors of Los Angeles and San Bernadino counties (Calif.), conducted a tour of seven overhead irrigation systems in the San Gabriel valley and foothills.

A. J. Brown, irrigation specialist of the Agricultural Extension Service delivered two short addresses at the McPherson and Johnson groves. He summarized the important findings of Prof. Wadsworth's recent detailed investigation of overhead irrigation as follows: 1. Overhead irrigation systems are costly. They restrict their use to valuable lands and crops. 2. Overhead systems distribute water more uniformly than any other system. 3. Experiences on light soil have shown very beneficial results from overhead irrigation. 4. The detailed designing of an overhead system requires the services of a competent engineer who will save the grower many times his fees.

C. J. Pegler's grove was first visited. His grove has been under an overhead system for some five years. He has a portable system that requires ten sets of his battery of sprinklers to cover the acreage. The small pipe works satisfactorily in his system. He said that at the present time he is raising more fruit with less labor and expense than he has ever before. He made the statement that he has had no brown rot gummosis since the installation of his overhead system. He pointed out the fact that this would tend to dispel any reports that overhead systems caused gummosis.

When the party reached the F. H. McPherson grove—sandy loam soil—they were told that the grove was last irrigated on May 10 with 2.4 acre inches of water. Recent soil auger tests to a depth of 4 feet have shown that ample moisture still remains in the soil. During the past year, the trees were watered with but 10.55 acre inches, but they have shown marked improvement over their condition of three years ago, according to the ranch manager.

Frank G. Webber, manager of the Sierra-Madre Citrus Association and newly elected president of the Lemon Men's Club, told the guests that he had noticed that the best colored oranges and the most evenly colored silver green lemons were coming from overhead irrigated groves.

C. M. Johnson discussed his problems of installation of wide coverage sprinklers, screening of ditch water and booster equipment. The pressure boosting costs on his Glendora grove offset his lessened ditch-water costs.

H. K. Needham opened the gates of his grove for the inspection of the procession. He reported a slight advantage in overhead irrigation methods as applied to his groves. He pointed out the dangers in spraying the groves too severely and in fumigating the growth that had been cleaned as a result of overhead irrigation.

The installations on the W. A. Johnstone and Meredith groves were seen on the way to California's largest installation of overhead equipment. A. M. Stephens, of La Verne, has 65 acres now under this method of irrigating.

OVERHEARD Among the OVERHEADS

A test plot installation has just been completed for the Placenta Fruit Company on a small acreage at Fullerton by A. E. Harris.

The Rose ranch, adjoining that of Dr. Matzen (at Escondido) has just had a five-acre installation made by F. L. B. Co. using new type Orr sprinklers. It is on side-hill land newly planted to citrus.

A fifteen-acre installation of Orr sprinklers has just been completed at Escondido, Calif., on avocados and citrus for Dr. Neil Matzen by S. H. Gerson. Of especial interest is a low pressure unit of special design that is operating satisfactorily on only fifteen pounds pressure.

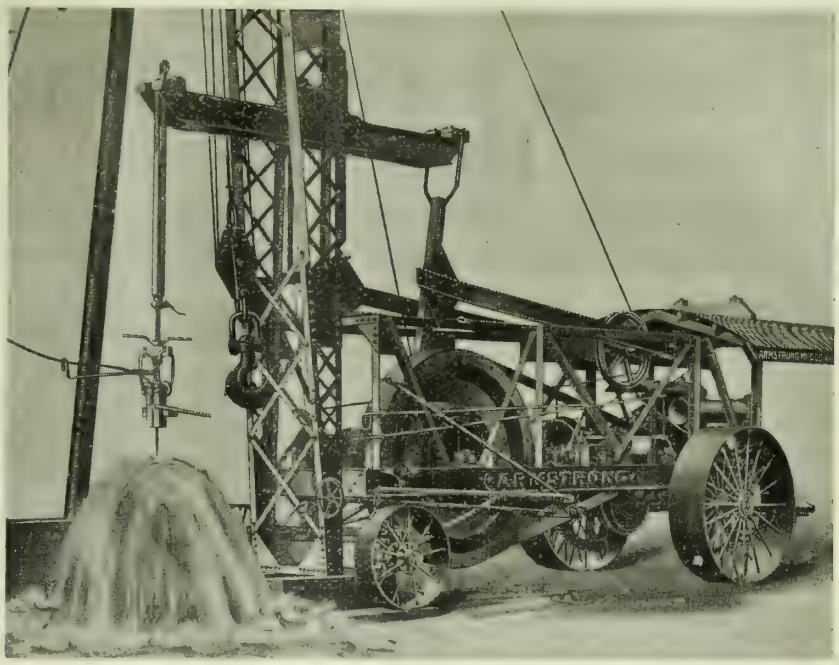
W. A. Buckner, president of the Buckner Manufacturing Co. of Fresno, Calif., one of the leading manufacturers of overhead sprinklers on the Pacific Coast, was in Southern California the greatest part of June, visiting various installations in that territory in company with T. E. Watson, his Los Angeles distributor.

So far as known, the overhead system requiring the widest coverage from its sprinklers is that of Geo. Barfoot at Anaheim, (Calif.), where the 24-foot setting requires a throw of 120 feet in diameter and gets it from the Orr compound sprinklers used with sixty pounds pressure. The instillation is just being completed by Sam H. Gerson.

A new planting of avocados on the extensive Spadra (Calif.) estate of W. K. Kellogg, the "Corn Flake King" is to be irrigated with an overhead system being installed by Albert E. Harris. Although the installation is but four acres in extent, it is understood to be only the first of hundreds of acres which may go under overhead on this property. Extensive plantings of alfalfa under overhead are planned.

The Vindicator Company, one of the pioneer overhead sprinkler manufacturers, formerly located at Vernon, has taken up headquarters in Glendale, Calif. Fengal C. Orr, developer and patentee of several sprinklers, has associated with him J. C. McNaught, for years well known in golf-course irrigation circles. Their plans include a production plant in the Glendale industrial district in the near future.

(*Overhead Department, Continued on Page 52*)



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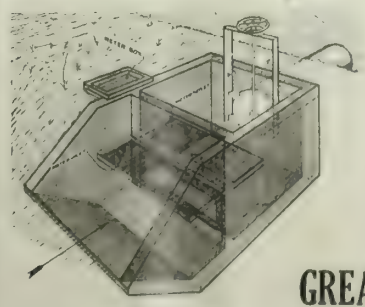

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SURVEY *of* HYDRAULIC DEVELOPMENT

As Shown by Official Records of the Month -- Local, State, and Governmental

Permits Issued

Among the more important permits to appropriate water issued by the Department of Public Works, Division of Water Rights of California, during the month of June, 1926, were the following:

Application No. 5042 (San Diego County) —Samuel W. Swan & Carl A. Davis, Room 9, Post Bldg, San Diego, Calif., for 2½ cubic feet per second and 33,000 acre feet per annum from San Felipe Creek, tributary to Salton Sea. To be diverted in Section 2, T 13 S, R 4 E, S. B. M. for irrigation and domestic purposes on approximately 20,000 acres in San Felipe Valley. Estimated cost $500,000.

Application No. 5046 (Sierra County)— Sierra Highland Mining Co., 401 Claus Spreckel's Bldg., San Francisco, Calif., for 5 cubic feet per second and 450 acre feet per annum from Lake Hawley and Hawley Meadows, tributary to East Fork North Fork Yuba River. To be diverted in Section 14, T 21 N, R 11 E, M. D. M. for mining purposes in Sections 33 and 34, T 21 N, R 11 E and Section 4, T 20 N, R 11 E, M. D. M. Estimated cost $60,000.00

Application No. 5047 (San Joaquin County)— Mrs. Louisa Stark, care of Ohm & Rabb, 517 E. Market St., Stockton, Calif., for 16.68 cubic feet per second from Salmon Slough and Middle River tributary to San Joaquin River. To be diverted in Section 23, T 1 S, R 5 E, M. D. M., Section 35, T 1 S, R 5 E, M. D. M., Section 27, T 1 S, R 5 E, M. D. M., for irrigation purposes on 1334.8 acres. Estimated cost $10,000.00

Application No. 5048 (San Joaquin County)—Helen H. Cleghorn, care of Ohm & Raab, 517 E. Market St., Stockton, Calif., for .22 cubic foot per second from Fourteen Mile Slough, tributary to San Joaquin River. To be diverted in Section 16, T 2 N, R 6 E, M. D. M., for irrigation purposes on 18 acres in Sections 16 and 17, T 2 N, R 6 E, M. D. M. Estimated cost $2,500.00

Application No. 5050 (Sonoma County)— Grand Lodge—Knights of Pythias of State of Calif., care of Jesse W. Carter, Redding, Calif., for .03 cubic foot per second and 7 acre feet per annum from Hood Creek tributary to Sonoma Creek. To be diverted in Section 18, T 7 N, R 6 W, M. D. M., for domestic and irrigation purposes in Section 24, T 7 N, R 7 W, M. D. M. Estimated cost $30,000.00

Application No. 5051 (Inyo County)—E. A. Ludwick, Box 674, Big Pine, Calif., for 3 cubic feet per second from Buckhorn Spring, tributary to Deep Spring Valley. To be diverted in Section 16, T 8 S, R 36 E, M. D. M., for mining and domestic purposes in Section 20, T 8 S, R 36 E, M. D. M.

Application No. 5052 (Inyo County)— Western Lead Mines Co., Beatty, Nevada, for .075 cubic foot per second from Willow Spring, tributary to Death Valley. To be diverted in Section 7, T 12 S, R 45 E, M. D. M., for mining and domestic purposes in Section 33, T 12 S, R 45 E, M. D. M. Estimated cost $10,000.00

Application No. 5053 (Inyo County)— Western Lead Mines Co., Beatty, Nevada, for .12 cubic foot per second from Big Spring, tributary to Death Valley. To be diverted in Section 2, T 12 S, R 44 E, M. D. M., for mining and domestic purposes in Section 33, T 12 S, R 45 E, M. D. M. Estimated cost $15,000.00

Application No. 5055 (Santa Cruz County) —Leonard & Holt, 220 Kearney St., San Francisco, Calif., for .20 cubic foot per second from Zayante Creek tributary to San Lorenzo River. To be diverted in Section 2, T 10 S, R 2 W, M. D. M., for domestic purposes on subdivision in Section 2, T 10 S, R 2 W, M. D. M. Estimated cost $25,000.

Application No. 5056 (Amador County)— Stephen E. Kieffer, Mechanics Inst. Bldg., San Francisco, Calif., for 300 cubic feet per second from Mokelumne River tributary to San Joaquin River. To be diverted in Section 15, T 5 N, R 10 E, M. D. M., for power purposes in Section 17, T 5 N, R 10 E, M. D. M. 9370 H. P. Estimated cost $1,500.000.

Application No. 5057 (Plumas County)— Feather River Tract Co., Room 804, 57 Post St., San Francisco, Calif., for 5 cubic feet per second from Dogwood Creek, tributary to Middle Feather River. To be diverted in Section 2, T 22 N, R 8 E, M. D. M., for power purposes in Section 35, T 23 N, R 8 E, M. D. M. 50 H. P. Estimated cost $15,000.

Application No. 5061 (Trinity County)— Big Creek Ranch Inc., care of N. D. Hopkinson, 68 Post St., San Francisco, Calif., for 40,000 acre feet per annum from Big Creek tributary to Hay Fork of S. Fork Trinity River. To be diverted in Section 6, T 32 N, R 11 W, M. D. M., for irrigation purposes on 22,000 acres in Townships 31 and 32 N. Ranges 10, 11 and 12 W. M. D. M. Estimated cost $200,000.00

Application No. 5064 (San Joaquin County) John H. Masters, care of Ohm & Raab, 517 E. Market St., Stockton, Calif., for .90 cubic foot per second from Burns Cutoff tributary to San Joaquin River. To be diverted in Section 12, T 1 N, R 5 E, M. D. M., for agricultural purposes on 72.4 acres in Section 14, T 1 N, R 5 E, M. D. M. Estimated cost $5,000.00

Application No. 5068 (Mono County)— Nevada California Power Co., care of W. L. Huber, 1st National Bank Bldg., for 30 cubic feet per second from Leevining Creek tributary to Mono Lake. To be diverted in Section 20, T 1 N, R 25 E, M. D. M., for power purposes in Section 16, T 1 N, R 25 E, M. D. M. Estimated cost $1,170,022.00

Application No. 5069 (Siskiyou County) —Geo. H. Cory, Callahan, Siskiyou Co., Calif., for 1 cubic foot per second from Little Carmen Creek, tributary to Grouse Creek. To be diverted in Section 29, T 40 N, R 7 W, M. D. M., for mining and domestic purposes in Section 29, T 40 N, R 7 W, M. D. M.

Applications Filed

Among the applications for permits to appropriate water filed with the State Department of Public Works, Division of Water Rights, (California) during the month of June were the following:

Permit No. 2516, Application No. 4841 (Yolo County) Issued to Mrs. P. J. Braun, Grafton, Calif., June 1, 1926, for 6.93 cubic feet per second from Sacramento River in Section 6, T 10 N, R 3 E, M. D. M. for irrigation of 277.07 acres of rice near point of diversion. Estimated cost $4,500.

Permit No. 2517, Application No. 4889 (Lake County) Issued to W. F. Detert, San Francisco, Calif., June 1, 1926, for 6.25 cubic feet per second and 600 acre feet per annum from Bucksnort Creek in Section 9, T 10 N, R 6 W, for use for irrigation of 1002 acres in Guenoc Rancho. Estimated cost $100,000.

Permit No. 2519, Application No. 3657 (San Benito County) Issued to Peter L. Swanson & Lillian J. Swanson, Hollister, Calif., June 4, 1926, for 1.4 cubic foot per second from San Benito River in Section 5, T 14 S, R 6 E, for irrigation of 186 acres near point of diversion. Estimated cost $5,000.

Permit No. 2529, Application No. 4768 (Amador & Calaveras Counties) Issued to East Bay Municipal Utility District, Oakland, California, June 15, 1926, for 375 cubic feet per second and 217,000 acre feet per annum from Mokelumno River in Section 26, T 5 N, R 10 E, for power purposes in Section 26. 13849 T. H. P. to be developed. Estimated cost $6,000,000.00

Permit No. 2534, Application No. 1097 (Mono County) Issued to Walker River Irrigation District, Yerington, Nevada, June 18, 1926, for 35,000 acre feet per annum from West Walker River in Section 27, T 6 N, R 22 E, for irrigation of 160,000 acres, stock and domestic near point of diversion. Estimated cost $167,500.00

Permit No. 2535, Application No. 1098 (Mono County) Issued to Walker River Irrigation District, Yerington, Nevada, June 18, 1926, for 115,000 acre feet per annum from West Walker River in Section 17, T 6 N, R 23 E, for irrigation of 160,000 acres near point of diversion.

Permit No. 2536, Application No. 1389 (Mono County) Issued to Walker River Irrigation District, Yerington, Nevada, June 18, 1926, for 57,000 acre feet per annum from East Walker River in Section 34, T 6 N, R 25 E, for irrigation of 160,000 acres near point of diversion. Estimated cost $330,000.00

Permit No. 2538, Application No. 2615 (Mono County) Issued to Walker River Irrigation District, Yerington, Nevada, June 18, 1926, for 200 acre feet per annum from unnamed stream in Section 27, T 10 N, R 22 E, for domestic and irrigation of 160,000 acres near point of diversion. Estimated cost $918,000.00

Permit No. 2539, Application No. 2342 (Nevada County) Issued to James F. Dunn, Salt Lake City, Utah, June 21, 1926, for 97 acre feet per annum from South Wolf Creek in Sections 19 and 30, T 15 N, R 9 E, for irrigation of 55 acres near points of diversion. Estimated cost $7500.00

Permit No. 2542, Application No. 4928 (Tuolumne County) Issued to Oakland-Piedmont Council Boy Scouts of America, Oakland, Calif., June 22, 1926, for 0.1 cubic foot per second from Middle Fork Tuolumne River in Section 15, T 1 S, R 19 E, for domestic and recreational purposes in Section 10. Estimated cost $2050.00

Permit No. 2543, Application No. 2665 (Trinity County) Issued to Humboldt Placer Mining Co., 427 East McLeod St., Stockton, Calif., June 22, 1926, for 75 cubic feet per second from Stuarts Fork of Trinity River in Section 31, T 36 N, R 9 W, for mining purposes near point of diversion. Estimated cost $250,000.

Permit No. 2544, Application No. 2666 (Trinity County) Issued to Humboldt Placer Mining Co., 427 East McLeod St., Stockton, Calif., June 22, 1926, for 25 cubic feet per second from Owens Creek and unnamed South Branch of Owens Creek in Section 12, T 35 N, R 10 W, for mining purposes near point of diversion. Estimated cost $7,000.00

Permit No. 2545, Application No. 2667 (Trinity County) Issued to Humboldt Placer Mining Co., 427 East McLeod St., Stockton, Calif., June 22, 1926, for 25 cubic feet per second from Van Matre Creek in Section 24, T 33 N, R 10 W, for mining purposes near point of diversion. Estimated cost $5600.00

Permit No. 2547, Application No. 4838 (Riverside County) Issued to James Kincheloe, Corona, Calif., June 23, 1926, for 3 cubic feet per second, from Bedford Canyon in Section 36, T 4 S, R 7 W, for domestic use and irrigation of 245 acres near point of diversion. Estimated cost $18,000.

Permit No. 2550, Application No. 4881 (Marin County) Issued to Bolinas Public Utility District, Bolinas, Calif., June 23, 1926, for 1 cubic foot per second from Arroyo Hondo Creeks in Section 9, T 1 N, R 8 W, for municipal purposes for Bolinas Public Utility District. Estimated cost $50,000.00

Permit No. 2551, Application No. 1990 (San Louis Obispo County) Issued to City of San Louis Obispo, Calif., June 23, 1926, for 2.32 cubic feet per second from Lopez Creek in Section 9, T 31 S, R 14 E, for municipal purposes in said city. Estimated cost $600,000.00

Permit No. 2553, Application No. 2302 (San Luis Obispo County) Issued to Victor A. Bentson, San Francisco, Calif., June 23, 1926, for 4.74 cubic feet per second from Arroyo Grande Creek in Ranchos Corral De Piedra & Santa Manuela within T 31 S, R 14 E, for irrigation of 378.81 acres near point of diversion. Estimated cost $20,000.-00.

Permit No. 2554, Application No. 4869 (Plumas County) Issued to Feather River Power Co., San Francisco, Calif., June 25, 1926, for 5 cubic feet per second from Pebble Creek and 3 unnamed branches of Milk Ranch Creek in Sections 6 and 7, T 24 N, R 7 E, for power purposes in Section 29, T 24 N, R 6 E. 1450 T. H. P. to be developed. Estimated cost $7,700,000.

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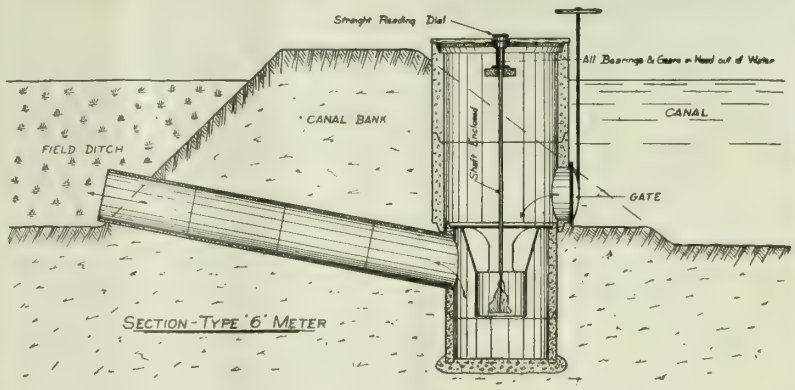

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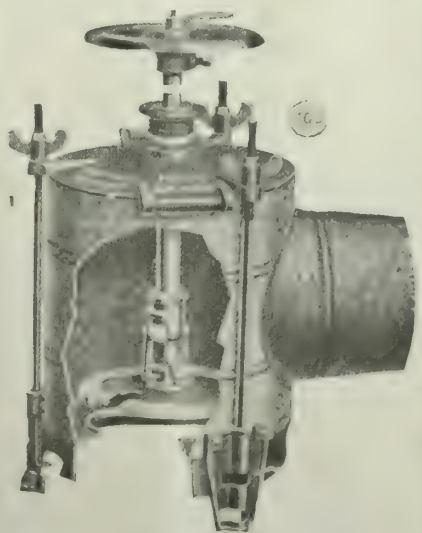

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OVERHEARD AMONG THE OVERHEADS

(*Continued from Page 49*)

The utilization of natural gas for booster pump power at a cost said to be but a fraction of the cost of electricity is a feature of the 18-acre system of oranges being installed for J. C. Gapp in the North LaVerne district by Clarence H. Thomas, one of the pioneer contractors. A Buda gas engine entailing an initial investment about 25 per cent greater than that of electric motor equipment is being used in the pump house and the new Lark sprinkler is to be installed.

An additional acreage in the Anaheim district has been installed for P. J. Weisel by the Browning Construction Company. Different systems and sprinkler heads are being tried out by Mr. Weisel, who is an extensive grower in various districts. His experience on the sandy Anaheim soil has been interesting with regard to the water used by the overhead as compared with the furrow method. His plant formerly pumped 100 inches of water for 48 hours to get over the twenty acres but through the overhead 50 inches of water gives it a better irrigation in four units in twenty-four hours total time of operation. This figures a quarter of the water formerly used and the leached condition of the soil is being replaced by cover crop humus.

WHAT IS *YOUR* PROBLEM

FREQUENT requests for authoritative, unbiased information on overhead irrigation systems, co-ordinating the hydraulic, mechanical and agricultural requirements thereof, has led MODERN IRRIGATION to secure for its readers the services of Lippincott and Stewart, consulting hydraulic and overhead irrigation engineers.

In this department, questions of general interest to overhead irrigators will be answered for our readers. Should special or earlier answers be desired, a stamped addressed envelope should accompany each inquiry. There is no charge for this service.

How much water will I need to run sprinklers on my eight acres? Can I get it through my two-inch meter? G. D. H.

Overhead irrigation systems can operate on from five to eight miners' inches of water per each acre under operation. Proper engineering of a system will take into account primarily the volume and pressure available, the soil porosity and surface gradient. With a pressure upward of fifty pounds your two-inch meter will admit sufficient water to operate up to two acres at one time, and a four-unit system would be necessary, unless, of course, the supply and the meter could be enlarged.

We have so much lime in our water that it quickly "limes up" on faucets and fittings. I believe it would be unsuitable for sprinkling onto vegetation. Please let me know what you think about such a condition?
S. A. R.

We have encountered this condition and opinion in two other localities. Preliminary experiments have shown no adverse effects on foliage but on account of the serious possibilities we are awaiting the results of conclusive tests which are being made by recognized plant chemists. Such conclusions will be reported in these columns.

Can I utilize my concrete line in any way in changing over from furrow to overhead irrigation? E. L. C.

No old type of concrete line can handle water under pressure sufficient to operate any standard sprinkler equipment. Possibly water could be conducted from the source or entrance to the property to the most economical booster pump location through the concrete line as laid. However, a new high-pressure type of concrete pipe is being developed and manufactured that offers possibilities for use in this field. Names of companies manufacturing such pipe will be supplied upon request. An article on this subject will appear in these columns in the near future.

OREGON

Among the more important applications for permit to appropriate water filed in the office of Rhea Luper, State Engineer of Oregon, during June, 1926, were the following:

Lewis E. Springer, William N. Palsgrove, and Albert M. Davis of Dufur, covering the appropriation of flood and surplus waters from Fifteen Mile Creek and Tamarack Creek for irrigation of 30 acres in Wasco County.

Jess Elliott of Copperfield, covering the appropriation of water from Pine Creek for irrigation of 10 acres, for the development of 3 theoretical horsepower, and to supply fish ponds in Baker County, at a cost of $1,000.

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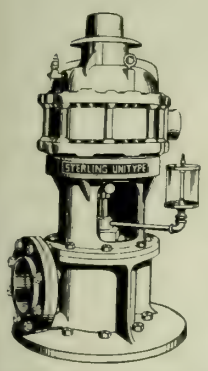

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John C. McFarland of LaGrande, covering the appropriation of water from Grande Ronde River for irrigation of 30 acres in Union County.

Bear Creek Land Company of Portland, covering the appropriation of seepage water for domestic purposes including garden irrigation; and also covering the appropriation of water from an unnamed spring for domestic use including garden irrigation in Clackamas County, at a cost of $10,000.

Wyatt Brothers of Mt. Hood, covering the appropriation of water from East Fork of Hood River for development of 30 theoretical horsepower in Hood River County, at a cost of $3,000.

Cary V. Loosley of Fort Klamath, covering the appropriation of water from Lenz or Big Springs Creek for irrigation of 1,320 acres and for stock water in Klamath County, at a cost of $1,000.

H. G. Masterson of Elgin, covering the appropriation of water from Wallowa River for irrigation of 60 acres in Wallowa County.

Mrs. E. M. Benson of Nyssa, covering the appropriation of water from the Nyssa-Arcadia Drainage Ditch for irrigation of 20 acres in Malheur County.

E. G. White of Hillsboro, covering the appropriation of water from an unnamed stream for irrigation of 17 acres in Washington County.

E. W. Kelly of Hood River, covering the appropriation of water from an unnamed spring for irrigation of 20 acres in Hood River County.

William M. Teeter of Elgin, covering the appropriation of water from Gordon Creek for irrigation and supplemental supply for 109 acres in Union County.

J. P. Abbott of Wapinitia, covering the appropriation of water from Tapa Spring for domestic use including stock water, and for irrigation of 20 acres in Wasco County.

Edward Bryant, et al, of Redmond, covering the appropriation of water from Lake Creek and Suttles Lake for irrigation of 12,000 acres in Jefferson County.

City of Warrenton, covering the appropriation of water from Lewis and Clark River for domestic and general municipal purposes at an estimated cost of $500,000.

Theo Lengele of Route 2, Salem, covering the appropriation of unnamed springs tributary to Rickreall Creek for domestic supply and irrigation of 30 acres in Polk County, at an estimated cost of $1,000.

City of Monroe covering the appropriation of water from Hewitt Spring for municipal water supply in Benton County, at an estimated cost of $5,000.

W. B. Lindsay & E. J. Schumacher of Merlin, covering the appropriation of water from Brockman Ditch from Quartz Creek for irrigation of 50 acres in Josephine County, at an estimated cost of $400.

A. E. & Sally Bush of Salem covering the appropriation of water from Labish Drainage Ditch and two springs for irrigation of 169.77 acres in Marion County at an estimated cost of $2,500.

Henri Walloert of Baker, covering the appropriation of water from Goodrich Creek for irrigation of 100 acres.

B. A. Huff, Dick Koopman and John Liggett of Pine, Baker County, for appropriation of water from Corral, Lake Fork Pine and Bigger Creeks, for the irrigation of 350 acres. No estimate given.

E. C. Wren of Hood River, covering the appropriation of water from Indian Creek for irrigation of 17 acres, at an estimated cost of $1000.

Breitenbush Mineral Spring Co. of Portland, covering the appropriation of water from Breitenbush River, for 375 theoretical horsepower, at an estimated cost of $2,500.

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AMONG OUR CONTRIBUTORS

Editorial Jottings About Current and Forthcoming Feature Articles, Dealing With Practical Problems of Hydraulics, and the Men Who Have Written Them

R. V. MIEKLE, who served as chief engineer in the construction of the Exchequer project began his technical engineering work in 1906 as a draftsman in the water department of the city of Portland, Oregon. For six years he served in various capacities on city water supply, power and irrigation projects in the northwest. He was graduated from draftsman to instrument man, and from instrument man to assistant engineer. He spent one year with the United States Department of Agriculture in California. In 1914 he was made chief engineer of the Don Pedro project for the Modesto and the Turlock Irrigation districts. Until the completion of the Exchequer Dam, he served as chief engineer on the project, and resigned on its completion to give place to a permanent operating organization. Mr. Meikle has written the leading article of this issue, summarizing in modest style the truly epic story of the Exchequer.

DOUGLAS G. MCPHEE, who tells of his interview with the Bent brothers on the construction of the Exchequer dam, has been executive editor of MODERN IRRIGATION since its establishment a year ago.

L. J. FLETCHER is professor of agricultural engineering at the University of California, branch of the College of Agriculture. He has been extremely active in the advancement of agricultural engineering as a distinct branch of the profession.

STUART B. SHOW, District Forester of the California district, United States Forest Service, writes this month on "How You Can Aid in Protecting the Forests." Mr. Show is a graduate of Stanford University, and received his technical education in forestry at the Yale Forest School. Born in Nebraska, he early came to California with his father, and has been an officer in the United States Forest Service for more than sixteen years. He started as a student forester on the Shasta National forest and has steadily advanced to the position which he now holds. His work has taken him into practically every forest in the state of California.

PAUL BAILEY'S personal sketch of the late W. F. McClure was written at the request of the editors of MODERN IRRIGATION. Because of his intimate contact with Mr. McClure, and because of his knowledge of his former chief's work in the irrigation field, Mr. Bailey is the man best suited to describe Mr. McClure and his service. Mr. McClure who was chief engineer for the State of California and head of the State Department of Public Works,

WILLIAM J. B. STEWART

died June 22. He was stricken by an attack of heart disease while on an inspection tour of the Sly Park dam site near Placerville, California. Mr. Bailey has for some time been deputy state engineer but he has written his sketch of Mr. McClure in the capacity of a friend and admirer who had exceptional opportunity to know the man and the work which he accomplished.

R. P. LEHR is associated with the Killefer Manufacturing Company, Los Angeles. He has given many years of study to irrigation, especially to cultivation and soil chemistry. A wide range of experience and a bent for careful observation have peculiarly fitted him to write on the value and effect of cultivation on irrigation. His article this month deals with a subject that is vital and basic in irrigation practice.

ROY W. CARLSON, whose article descriptive of the tests and measurements which are being made on the Engineering Foundation's test dam on Stevenson Creek appears in the hydraulic engineering department of this issue, is connected with the Southern California Edison Company, and has been for some time active in that company's work in the Big Creek region. Mr. Carlson received collegiate training at the University of Redlands (Calif.) and subsequently did graduate work and research study in physics at the California Institute of Technology in Pasadena, California. During the years 1924-25 he was acting associate professor of physics at the University of Redlands.

RAY L. DERBY, whose article describes his experiences with the sulfur dioxide problem, was born in Brooklyn, N. Y., June 14, 1898, received his preparatory education in the schools of Los Angeles County, and was graduated from the University of California in 1922, after having spent some time in the U. S. Army and in surveying work for Los Angeles County, and the California Highway Commission before receiving his degree.

While in college, Mr. Derby won the James Munroe McDonald Scholarship for Sanitary Engineering Students. Upon graduation, he entered the employ of the California State Board of Health as assistant sanitary engineer, resigning in July, 1923, to accept his present position as sanitary engineer with the firm of Salisbury, Bradshaw & Taylor, consulting engineers of Los Angeles.

CARL E. GRUNSKY is a past president of the American Society of Civil Engineers. Mr. Grunsky is a native of California but obtained his higher education in Europe, in Germany and England. He ranks today as one of the best known of the engineers of the West and entire country. He is a member of the Board of Editorial Advisors to MODERN IRRIGATION.

WILLIAM J. B. STEWART is a consulting hydraulic and overhead irrigation engineer. He introduces this month in MODERN IRRIGATION a new department which will run regularly in the future, dealing with practical overhead irrigation problems.

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For 12 Months, $2.00. Single Copies 20 cents.

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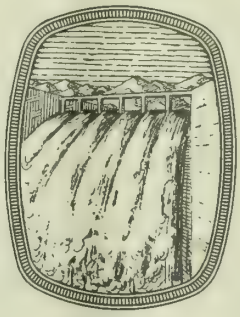
PAUL BAILEY

Who was appointed California State Engineer and Director of Public Works on July 17 to succeed the late W. F. McClure. Mr. Bailey has for some time been deputy state engineer, working hand in hand with his late predecessor. The report which he submitted to Governor Richardson last month, concerning the future water supply for Southern California, a subject of practical interest to engineers and water developers throughout the West, is printed in full in this issue of MODERN IRRIGATION.

MODERN Irrigation
The Magazine of Applied Hydraulics



Volume II AUGUST, 1926 Number 8

The Progress *of* Irrigation

THE tremendous advance of irrigation can be perceived, in proper perspective, only as one draws away from individual projects and views all projects as one huge movement to bring fertility to hitherto arid communities. Controlling nature's forces for man's use is nowhere practiced with greater skill, or with more consummate success, than in Western America, where, seemingly every month brings the inauguration of another big water development.

The number of projects planned, under construction, or recently completed, when viewed in panorama, amaze one with the immensity of their physical—as well as their fiscal—aspects. Only a review of projects now in the making can give the reader an adequate conception of the progress of irrigation.

The Exchequer Dam, the most recently completed of the larger projects, has begun to function. Members of the Merced irrigation district, which it serves, have expressed themselves as being in favor of a managerial form of government instead of a highly complicated machine, such as the board of directors had, it is reported, originally arranged for.

The Nevada Irrigation District reports that fourteen hundred men have been employed and that work is progressing rapidly on the project as a whole. A chain of 20 camps has been established to house the men working at the various phases of construction. The great rock dam at Bowman is approximately 40 per cent completed. Seven hundred and fifty acres of timber are being removed to provide for further storage space in the reservoir area. The ten mile conduit is rapidly taking form, and the long bore that will go from end to end of the project has been started. It is interesting to note that the site for the district's present construction was selected 50 years ago by Hamilton Smith.

On the Mokelumne project, Oakland, contractors have been instructed to proceed with the construction of the concrete dam and power house at Lancha Plana, the district having received the permit from the Federal Power Commission. The contract price has been set at $3,081,378. The contractors have been instructed to proceed with the Lancha Plana tunnel on a price basis of $624,045. Camps have been established and excavating has begun on the east heading of the Claremont Tunnel.

Other important irrigation projects

include the winning of a fourteen year struggle by the Pecos, Texas, Irrigation District for the right to construct a dam on the Pecos River for the irrigation of some 110 miles along the river.

Bids will be called for soon on the construction of the $5,500,000 multiple-dome type, concrete Coolidge Dam for the United States Indian Service near San Carlos, Arizona.

Bids will be called for the $3,000,000 Gibson concrete dam, Sun River project for the United States Reclamation Service at Fairfield, Montana.

A bond election will soon be held for the $1,250,000 earth fill dam to be erected in connection with a canal system for the Lovelock Irrigation District, Nevada.

The state of Sonora, Mexico, reports a 10,000,000 dollar project for a dam and canal system. The Mexican federal government has given instructions to proceed with the first unit of its vast irrigation program with the initiation of work on the Aguas Calientes project.

A bond election is in the offing for a $1,750,000 project to include concrete dam, canals, and syphon for the El Doroado Irrigation district, Placerville, California.

The engineering Commission of the Kings River Water Storage District, California, will soon file a report on the proposed $20,000,000 Pine Flat project.

First concrete has been poured for the Frog Tanks Dam, Maricopa County Water Conservation District, Arizona. Seven miles of transmission power lines have been completed with the establishment of the construction camp. Four hundred men are employed on the project, working in three shifts, with the entire layout flood lighted. This will be what is said to be the highest multiple arch dam in the United States when completed.

The Horse Mesa dam in Arizona, when completed, will be three hundred feet high and fifty-three feet thick. Concrete pouring has started on this project. It is estimated that over 40,000 horsepower of hydro-electric energy will be developed when the dam is completed in April, 1927.

Ninety-one thousand cubic yards of concrete will be involved in the Melones Dam, San Joaquin and Oakdale Irrigation District, California. The dam is now over 150 feet high, and will be completed by September, 1926, it is said.

Earth fills on both ends of the American Falls Dam, U. S. Reclamation Service, Idaho, have been sprinkled and rolled. Over a thousand cubic yards of concrete is being poured daily with a large crane and a two-yard bucket. Some 130,000 cubic yards of concrete, 1,300,000 pounds of reinforcing steel, and 1,800,000 pounds of gate and penstock metal have been installed to date. Four hundred and twenty-five men are working to complete the dam by June 1927.

The reader will look at this photograph and probably wish that by some magic or other he might be transported to this delightful spot. The most remarkable fact about the locality would escape him, however, if he did not know that a few short years ago there was nothing here but sandy, barren waste. Fertilization and irrigation turned the trick.

The first concrete has been poured on the dam that will be the highest of all types in the United States near San Fernando, California. This is the Pacoima Dam, one of the important flood control projects of Los Angeles County, California. It has been estimated that the dam will take approximately a year to complete.

These are projects under way in the United States alone. When one considers that other irrigation works are bringing fertility to the soil the world over—in Mesopotamia, Mexico, Spain and Australia—some idea of the magnitude of the movement can be conceived.

The discouragement and low morale which recently existed on some of the Federal reclamation projects in the West have been suplanted by a spirit of confidence and optimism, according to a detailed special report made in July by Reclamation Commissioner Elwood Mead to Secretary Work.

Good Judgment is *Half-way Between* Arbitrary Rules *and* Guesswork

By CHARLES A. JENSEN

General Superintendent, Limoneira Ranch, Santa Paula, Calif.

IT IS usually assumed that the most favorable percentage of moisture in soil for best citrus tree growth is what is called the "optimum" moisture content, and that the nearer this moisture condition can be obtained the better. Without discussing now whether this broad assumption is true, it is the condition of soil moisture that one intuitively likes to maintain. The term "optimum" soil moisture is a loose one in meaning, and it covers a wide range of soil moisture percentage depending upon the physical texture of the soil. Before using the term any further it may be desirable to explain the general meaning of it from a definite point of view.

A number of years ago Drs. Briggs and Shantz in the Bureau of Plant Industry of the U. S. Dept. of Agriculture, determined experimentally the amount of moisture left in different types of soils after plants of various kinds had been grown in them long enough to go into permanent wilt. The term "permanent wilt" in this work meant that the plants had used up so large a proportion of the soil moisture that the plants, still in their soil containers, remained in a state of wilt when transfered to a chamber saturated with water vapor.

An interesting result found was the important practical point that when different types of plants were grown in the same type of soil, each type of plant left in the soil approximately the same percentage of moisture when the plants wilted and could not recover their turgidity when brought into a vapor saturated air.

That is, a grain plant, a corn plant, or a cactus plant, and other types of plants used, left approximately the same percentage of moisture in any one type of soil when the "permanent wilting" point had been reached. The percentage of moisture left in the soil when this plant condition obtained was called the "wilting coefficient," and this percentage varied with the physical texture of the soil used. This finding incidentally refutes an opinion sometimes heard expressed that plants take moisture from the air when they cannot obtain the necessary amount of soil moisture to maintain growth. A moist air simply retards the transpiration of the plant because of the higher vapor pressure of the moist air surrounding the leaves; the plant does not take into its system enough "air moisture" directly to be of economical consideration.

Defines "Moisture Equivalent"

When a handful of soil is put into a tube which has a perforated bottom, and the soil saturated with water, some of the soil water will drain away, but the soil will hold a certain amount of moisture against the pull of gravity. The investigators above-named found that when they subjected a water-saturated soil to a centrifugal force equal to one thousand times the pull of gravity that the percentage of moisture left in the soil bore a certain relation to the amount of moisture left in the same soil when plants were grown in it to the wilting point. The percentage of moisture left in soil after being subjected to a pull equal to 1000 times the pull of gravity for about 30 minutes was called the "moisture equivalent". The moisture equivalent thus determined in the laboratory divided by 1.84 gives approximately the wilting coefficient.

Now to get back to the term "optimum soil moisture." It was found that the moisture equivalent approximated the optimum soil moisture content. In a light or sandy soil, the optimum is a little higher than the moisture equivalent; in a medium loam soil it is about the same; in a heavy or clay soil it is somewhat lower. The "available moisture" in a soil is considered to be the difference between the moisture equivalent and the wilting coefficient. Irrigation control, then, carried to its logical limits, would consist of making moisture determinations of the soil under consideration and comparing the amount found with the wilting coefficient of the same soil as determined in

LEFT: Men's dormitory, in which single men on the Limoneira are comfortably housed. RIGHT: Irrigating Limoneira lemons. These large trees have their root systems throughout the entire soil area and require full irrigation. The soil in this part of the ranch is so open that a five-minute run of about 10 inches in a furrow completes the irrigation. Compare with opposite extreme, *illustrated on Page 12*

the laboratory. Then the question arises, whether to irrigate or not, and how much water to apply.

Theoretical Considerations Applied

After these few preliminary remarks concerning the principle underlying soil moisture control, we will consider the specific methods used in handling the soil moisture problems on the various divisions of the Limoneira Ranch. From the foregoing discussion it appears that it is a simple matter to determine the amount of soil moisture present and apply water when necessary. Field conditions present problems quite different from that of soil moisture determination. In what relation to the tree shall the soil sample be taken? What depth of soil moisture is of significance to the tree growth? Are the trees large or small, thrifty or unthrifty? How will irrigation and the accompanying grove operations affect lemon picking? What are the weather conditions going to be in the immediate future? Is the water supply of each irrigation division such that a given number of groves can be irrigated by a certain time?

Irrigating lemons on the Limoneira Ranch. These trees are not yet using all the soil; hence the furrow centers are not being irrigated. This particular soil type requires a run of about 24 hours of penetration.

Some of these questions, and others that arise, often without warning, can be answered definitely, and others, from the nature of things, cannot. The general complication is such that after considering the factors in their entirety, one of which is time and expense, we decided early in the work that it was not practical to attempt to control irrigation definitely by constant soil moisture determinations. We make soil moisture determinations, but only to train ourselves to judge off-hand in the field the amount of soil moisture present, and the time to irrigate is decided on the spot. We have had the moisture equivalent and the wilting coefficient determinations made on the representative soil types and train ourselves to tell in the grove how much moisture is present, and to tell the irrigation foremen how much water to apply and when.

In what relation to the tree should the soil sampling be done? We know from numerous observations, some opinions to the contrary notwithstanding, that the soil immediately under the tree is well supplied with fibrous roots which use water in considerable quantity. This is the first soil area that gets dry. The drying of the soil extends gradually from under the tree to the skirt of the tree and the last area to get dry is out in the furrow centers; notwithstanding the fact that the former area is in the shade and the latter in the sun. In many groves, depending on the general tree conditions, the furrow soil area never gets dry enough to approach the wilting coefficient.

Depth of Soil Moisture

What depth of soil moisture is of significance to lemon tree growth? It has been shown in other areas that about 80 per cent of the feeding root system is in the top 30 to 36 inches of soil in a medium loam; about 90 per cent in the top 30 inch soil layer in a clay soil; in sandy soils the distribution was found to be deeper. We have made no such investigations on this ranch, but correlating soil moisture conditions with the tree condition, we know that by far the most of the lemon root systems in most of our soils is in the first three feet; on certain of our soil types in the first 2½ feet; and on some of our sandier types we consider 3 or 4 feet of soil in our irrigation control.

This pictures to us the following:

The volume of soil moisture that is vital to the lemon tree can be considered as an inverted cone, the drying beginning near the tree trunk and the cone drying gradually from the top down and from the center out. The irrigation control problem is to decide how large to permit this cone to become. In a grove of very large thrifty trees of about 112 trees to the acre, the cones easily meet in the furrow centers, rows about 24 feet apart. In groves of medium sized trees and in others of unthrifty trees, the amount of soil moisture in the furrow centers concerns us not at all; in fact they have but very little water applied to them.

Try New System

It was decided last year to test the effect of irrigating closer to the trees than was customary. A grove of large Lisbon trees, 10 years old, rows about 26½ feet apart, was selected for the experiment. The average distance between the centers of the inside furrows was about 10 feet in the row furrowed as usual and about 6 feet in the row furrowed closer to the tree. As the lateral movement of the irrigation water was about 18 inches from the center of the furrow, there was an unirrigated strip of land in the tree row of about 7 feet wide in the row furrowed as usual, and a strip about 3 feet wide in the row with the furrow closer to the tree.

A set of lemon fruits was measured periodically on each row of trees, one set being begun on April 30, and terminating on Sept. 23. Measurements of another series was begun on July 31 and terminated on Nov. 27. Table No. 1 gives the data obtained in a condensed form. The results show that putting the inside furrow closer to the tree increased the average size of the fruit by about one packing size, produced larger green fruit and a smaller percentage of yellow fruit. Measurements of the second and later series of fruits showed a gain of a little less than one-half packing size from July 31 to Nov. 27. Rain

TABLE NO. 1.—Growth of lemons on trees irrigated so as to leave: (1) 7 feet of dry soil in the tree row and: (2) 3 feet of dry soil in the tree row.

Remarks	Aver. gain in Dia. of all fruits 4-30 to 9-23		Aver. gain in Dia. 4-30 to 9-23 in 16th inch		Percent Yellow Fruit
	In 16th in.	In percent	Green Fruits	Yellow Fruits	on 9-23
7 ft. dry strip	12.5	62	14.4	11.6	65
3 ft. dry strip	14.4	75	15.6	13.4	49

at that time interfered with the continuation of the experiment.

These experiments partially answer the question of what soil area is most important in supplying soil moisture to the lemon tree. Accordingly we examine most closely the soil moisture under the tree, or at least under the skirt of the tree. The soil dries out from the surface downward, and when we find that the soil under the skirt of the tree or just outside has dried out to about the wilting coefficient to about 18 to 24 inches quite uniformly we find it advisable to irrigate soon. I say uniformly; it is surprising how much faster the soil dries out on the sunny side of the tree. Dry soil to a depth of 18 to 24 inches on the sunny side of the tree only, does not necessarily call for irrigation because the other side of the tree may be plentifully supplied with soil moisture. The experiment given above also gives us reason for the practice of frequently irrigating with only two furrows on each side of the tree, letting the furrow center area wait till the next irrigation.

Is Optimum Advisable?

Is the maintenance of an "optimum" soil moisture supply advisable? It was attempted to answer that question also by means of lemon fruit measurements. Another section of the same grove was used. Eight rows of trees were irrigated regularly every 30 days; eight rows were allowed to dry to the wilting coefficient well beyond the tree skirts, but not in the furrow centers; eight rows were irrigated "normally", that is, according to our best judgment. One set of lemon fruits was measured from July 8 to Nov. 23. Rain terminated the experiment on the latter date. Table No. 2 gives the data obtained.

TABLE No. 2.—Growth of lemons on trees receiving irrigation (1) normally, (2) every 30 days, (3) when dry.

	Aver. gain in diameter from 6-11 to 11-23						Percent of fruit			
	of all fruits		Ripes		Yellows		on 9-23		on 11-23	
Irrigation	in 16th's	in %	in 16th's	in %	in 16th's	in %	Green	Yellow	Ripe	Yellow
(1) Normal	13.7	67	12.5	60	14.6	73	83	17	45	55
(2) Every 30 days	12.0	58	9.7	46	14.0	70	76	24	46	54
(3) When dry	11.1	52	10.2	47	14.8	73	62	38	80	20

The table shows that the so-called "normal" irrigation produced best lemon fruit growth, and as it is our general observation that fruit growth is an indication of the tree condition we may be warranted in stating that the normal irrigation was also best for tree growth. The measurements of the second or later series of fruits showed the same general result in kind but the differences were not so great. These results question the broad assumption stated at the beginning of this article that it is usually assumed that it is desirable to maintain as nearly as possible an optimum soil moisture condition for citrus tree growth.

The above experiments emphasize the fact that one must not keep one's nose too close to any one factor that concerns citrus tree growth. The trees irrigated every 30 days were not at any time too wet in the usual sense. I think the soil moisture condition would have been called very good at all times. The soil drains well, is medium loam to heavy loam, has a moisture equivalent of about 18 per cent, wilting coefficient of about 11 per cent, and the trees were very vigorous in growth, producing much healthy foliage and a large crop of fruit.

A factor to be kept in mind is the necessity for proper soil aeration; and when a soil is kept in an almost continual state of "optimum" moisture, aeration is not as thorough as when the soil is allowed to dry out more. The soil organisms which do the most good are those that obtain most of their oxygen from the air and proper irrigation and cultivation is probably as important to them as to the orchard trees. We know they are agricultural friends and they probably need coddling as well as the trees.

Nothing has so far been said about irrigation intervals. So far as this ranch is concerned there is no such term. Intervals have varied from 30 to 120 days depending upon factors too numerous and tedious to mention, but the main one being naturally the soil moisture content coupled with the judgment of the person responsible for the irrigation.

Irrigating typical young trees on the Limoneira. Those at the right are 7-year old Valencias, transplanted; and on the left are 3-year old nursery Valencias. The lima beans between the trees help pay the way for young orchards.

Cultural practice has not been mentioned, and no erratic policy is followed in that respect. A soil mulch is established as soon after irrigation as the soil permits, shallow at first and deeper later. We consider a good soil mulch important because we have often noticed that when odd trees or corners of orchards are missed by the cultural tools, these trees do not have as thrifty an appearance as those cultivated, and the soil dries out faster, theories to the contrary notwithstanding. We find that the soil mulch not only conserves the moisture below the mulch, but, judging by our laboratory investigations, the nitrate producing organisms are more active where we have compared deep and well tilled portions of the same grove with adjoining areas not as well tilled.

The amount of water to apply in order to bring the soil moisture content up to approximately the moisture equivalent is not difficult to determine theoretically. It is difficult, however, actually to apply a given amount of water to our groves. In some portions of the citrus areas of the state this can be done with some degree of accuracy, because of the physical condition of the soil. The soils in the general area which concern us take water too readily for the best water economy to be practised. While our soils will pack they, nevertheless, take water so readily that it is necessary to rush the water through and change the settings quite soon after the water

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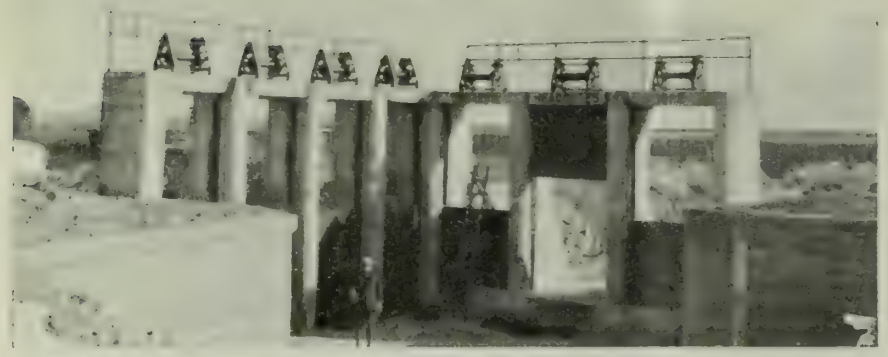
Colonization Succeeds Here Under Government Auspices

From Insolvency to Prosperity via Government Aid

By C. J. BRODERICK



Branch canal headgates on the Lethbridge project, Alberta, Canada. These are no small playthings, as can be seen by comparison of their size with that of the husky farmer lad in the foreground.

THE CANADIAN province of Alberta had a problem on its hands when irrigation water first flowed through the system of the Lethbridge Northern Irrigation District. To a large extent it is indebted to an American irrigationist, Dr. John A. Widtsoe, who pointed the way to its solution. Although the district is not yet "out of the woods" the path is now pretty well defined.

The problem was not one of engineering. Our problem, like most irrigation problems, came after construction. It had nothing to do with operation. It was the age-old problem of human nature that had to be met. During the rush and noise of construction, enthusiasm was keen among the farmers. The reaction came when the first assesment notices went out.

Human Nature Crops Out

The canals and structures were there, the water was already increasing production. The money raised on the bond issue had been spent. Theoretically, repayment should now commence. Everything had worked out well on paper. Why should it not work in practice? Something was wrong.

The system had cost $5,500,000.00 to construct, and the area of the project was 100,000 irrigable acres. Each acre was assessed $5.25, $1.25 of which covered operation and maintenance. The assessment during the first seven years paid the interest and operation costs. After that an additional dollar was to be assessed to retire the bonds in thirty years.

The crux of the matter was that the farmers could not pay $5.25 per acre. Under the law which incorporated the farmers into an irrigation district, lands in arrears of taxes would be forfeited within two years. It is not surprising that the farmers faced the future with concern. They had wanted irrigation, they needed it badly, but they had not counted the cost. It was up to the Provincial Government, which had guaranteed the bonds, to pay if the farmers could not.

Recurrent dry spells had driven these farmers to irrigation. They had prospered in the past during a period of wet years. Substantial homes and communities had been built. On all sides there was an abounding faith in the fertility of the land. Dry years had put them in debt and now with the advent of irrigation each acre had to assume a further obligation of $55.00.

With small holdings of a quarter section or less the assessment might not have been too heavy, but for years this district had been farmed dry in large wheat ranches. Individual holdings ran from 320 to 1280 acres. With irrigation, all land under the ditch was assessed its proportion whether it produced or not. These large farms had to be cut down. Maximum production alone would solve the problem, and new settlers were imperative.

But, if the old settlers could not pay the assessed rate, how could new settlers be expected to pay it? Something had to be done at once if the tax payers of the whole province were not to be saddled with a white elephant.

It was a "Farmers' Government," which had been in power only three years; a "class movement," it was called by old line parties. "Group domination" was another term applied to it. Perhaps it was all of these, but no prejudice was apparent in the way it dealt with this, a purely farmers' problem. No heed was given to the appeal that the province should absorb part of the capital cost by general revenue. Rather —the Government stated—the farmers in the Lethbridge Northern district itself must assume the full payment. An adjustment might possibly be made in the rates, however, until the farmers had had a chance to change over from dry to irrigated methods.

In the United States a similar problem was being studied. A Commission was even then looking into the question and it was being stated that the U. S. Government would have to wipe off many millions as a loss.

An American Comes to Help

On this Commission sat Dr. John A. Widtsoe. He was well known in Alberta irrigation circles. The Alberta Government invited him to consult with it on the problem of the Lethbridge Northern district. He came, and the legislation now known as "The Lethbridge Northern Colonization Act" was the result. It is too early yet to say that the Lethbridge Northern district has its full strength, as a result of Dr. Widtsoe's prescription, but the progress is encouraging, after a year and a half of treatment.

The essence of the legislation lies in the "Home Place" plan. Much idle land in the district was held by absentees. More land was held by resident farmers in excess of what could be profitably farmed under irrigation. Dr. Widtsoe said, "We will establish each *bonafide* the "Home Place" plan. Much idle land a unit commensurate with the farmer's

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and Here Private Management Brings Satisfied Customers

Once Shifting Desert Sands Now Intensive Cultivation

By PHILIP B. HASBROUCK

DEVELOPMENT and colonization of unused lands in the arid west has for many years been a subject of great interest not only to the settlers in that part of the country, but to both the state and national governments. Such development and colonization work has been carried on by individual settlers, by co-operative organizations composed of settlers, by outside capital seeking to make a profit from the sale of the lands, and by different government agencies. The various projects undertaken in these ways have not been uniformly successful. Some have succeeded and are now well settled portions of the states and counties in which they are located, containing cities of considerable size; others have been complete failures and have gone back to the original desert condition. Between these two extremes are the great majority occupied by agriculturists who make a better or worse living on their tracts. On some of the federal government projects it has recently been necessary to charge off as losses the payments due the government from the settlers, on the ground that the settlers cannot make a living.

In view of this situation, there is interest for irrigation readers in an account of a development and colonization project which is now almost completed, which has made a very marked success in attracting the right kind of settlers and in locating them on land where they are making a living and a profit.

The life blood of the valley—Lytle Creek. This creek has brought the surface soil which is now Fontana Farms, and today furnishes both water and power.

The Project's Setting

This project is known as Fontana, and is situated in the San Bernardino Valley (California) about eight miles west of the city of San Bernardino. The San Bernardino Valley at this point is some ten miles wide, extending from the Cucamonga Mountains on the north to the Jurupa Hills on the south. The floor of the valley here has been formed by the wash from Lytle Creek which flows out of the mountains from the north, and this wash has taken the form of a cone with the apex at the mouth of Lytle Creek Canyon and the base spread out over the valley almost to the southern boundary. The slope from north to south is not far from 80 feet per mile. The fill in the valley, which has been made by the accumulation of debris from Lytle Creek, is very deep, and this depth has been explained by the assumption that the country south of the San Andreas fault which runs in a general east and west direction along the base of the San Bernardino and Cucamonga Mountains has been gradually sinking during recent geological times, while the country north of the fault has been gradually rising and has formed the mountain range. As the country south of the fault has settled, the different streams, similar to Lytle Creek, flowing into it from the north have filled it up with debris washed out of the mountains, and this process has gone on until the valley fill can be drilled for water to the depth, in many places, of 1000 feet or more, without striking bed rock.

The valley in general, and Fontana in particular, is traversed by three main lines of railroad, and by two main highways. The city of Rialto adjoins the Fontana Tract on the east, Bloomington to the southeast, while the nearest cities to the west are Upland and Ontario.

Poultry raising forms one of the corner stones of livelihood on this project. A view of part of the company's trap-nested stock whose eggs are available to settlers on the property.

Back in the 80's, this entire district was sub-divided by the Semi-Tropic Land & Water Company. The original tract included both Rialto and Bloomington, and a strip of land running up the west side of Lytle Creek to the mouth of the canyon. The western boundary of the tract, which is now the western boundary of Fontana, was six miles west of Bloomington, making the entire tract as originally laid out nine miles from east to west, and ten miles from north to south.

Fourteen or fifteen years ago, when Rialto and Bloomington were well developed cities, and the country around them had been developed into bearing citrus groves and was in a high state of cultivation, the west end of the tract had reverted to the original desert, giving the appearance of being practically irreclaimable. The surface soil consisted of wind driven sand, and would have appeared hopeless as far as development into homesites was concerned, to anyone of less faith and optimism than the founders of the Fontana Tract.

These men believed, however, that the wind could be overcome by windbreak trees, and that the sand, when freed from wind action, could be converted into extremely fertile soil by the use of proper methods of cultivation and fertilizing, and they took over some 16,000 acres of the original Semi-Tropic land and have developed them with the results that can now be seen by anyone passing through on the highways or railroads, for the entire tract is planted and cultivated and is rapidly filling up with high class homes and contented settlers.

The first matter that had to be considered in such a project naturally had to do with water supply, and this was gone into very thoroughly. The water rights and water supply owned and used in Fontana are administered by two mutual irrigation companies, the Fontana Water Company and the Fontana Union Water Company. These are California corporations of the usual mutual irrigation company type.

The original securing of water rights was a long and complicated process, and need not be described here, but the Fontana Companies now own prior rights to both surface and underground flow from Lytle Creek, amply sufficient in wet years to irrigate the entire 16,000 acres in the tract. Together with other users of water from the stream, they practice spreading water during the winter season when there is excess flow of storm water, and thus build up the supply in the underground basins. This spreading is done on waste ground near the apex of the cone described previously in this article, and is the most effective form of conservation that can be practiced. Their deep wells reach these underground basins and thus give them a means for reclaiming the water there contained, late in the season when all the excess runoff has gone by.

In addition to the pumping plants on the underground flow, immediately below the mouth of Lytle Creek, the companies have plants of an even larger capacity in the main tract south of the Santa Fe Railway, some six miles south and four miles west of the creek mouth, which reach an underground storage which, so far, has proved inexhaustible. This source of water is drawn upon in dry years when the creek flow has declined to a point insufficient to meet the requirements of the acreage being irrigated.

All gravity flow from the mouth of Lytle Creek is conducted through a power house owned by the Fontana Power Company, and there furnishes power to operate the wells on the gravel beds in the near vicinity.

The total water supply of the Fontana Companies at present available stands at a minimum of 3300 inches, based on a dry season creek flow of 600 inches, 1300 inches from the upper pumps and 1400 inches from the lower pumps. This is ample for the irrigation of the entire 16,000 acres under the management of the companies, using an average duty of water of one inch to five acres.

The cost of irrigating water will vary from year to year according to whether the gravity supply from Lytle Creek is a large or small proportion of the total supply, as the cost of power for pumping is a large item in cost of operating, and no power is needed to handle the gravity supply. At no time, however, is this cost excessive, and a fair average is $16.00 per acre per year for citrus land, diminishing to as little as $8.00 per acre per year on vineyards.

With future water supply assured, needing only to be developed from time to time to keep pace with additional plantings, the management adopted a policy of planting all its lands to various crops before placing them upon the market. Five thousand acres were planted to citrus fruits, five thousand acres to vineyards, and about 1000 acres to deciduous fruits and olives. In addition to this they have recently set out about six hundred acres of walnuts, and there are also close to thirteen hundred acres of the vineyard lands which have walnuts interplanted with the vines. During this period, when the plantings were being made, the company operated under one management the largest diversified farm in the world.

Reference has been made to the soil, to all appearances consisting almost entirely of wind-driven sand. This was actually the case, and this soil, while very easily worked, was naturally lacking in humus, and required extensive and long continued fertilizing to build up a supply of humus and other plant food necessary for the successful grow-

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Garbage collected at a great many back doors in the city of Los Angeles is carried to this ranch to feed its 35,000 head of hogs, said to comprise the largest hog ranch in the world under one management. Pork raising forms an important part of Fontana's industry.

Program Completed for American Water Works Convention at San Diego Oct. 28-30

Notable Group of Western Authorities Will Read Papers Before Seventh Annual Meeting of Association's California Section; Trips for the Ladies

PLANS are rapidly taking form for the seventh annual convention of the California Section of the American Water Works Association to be held at San Diego, California on the 28, 29 and 30 of October. Paul E. Magerstadt, secretary of the California Section, announces that the program is complete and that a group of papers notable for their scope and practical interest, have been arranged for.

Officers of the association are, C. B. Jackson, Fresno, president; S. B. Morris, Pasadena, vice president; P. Diederich, Glendale, and John Burt, San Rafael, members of the executive committee; and Mr. Magerstadt, secretary.

Water works authorities and others well known to the profession will appear before the convention. The roster of speakers include William Mulholland, chief engineer of the department of Public Service, Los Angeles, who will speak on "The Colorado River Project," and C. G. Gillespie, director of the California State Board of Health, who will present his paper on "Iodine in Drinking Water." "Description of the Impounding Works of the San Diego Water System" will be the topic of a paper to be presented by R. C. Wueste, supervisor of impounding system, San Diego Water Department.

Entertainment Arranged

The entertainment program has practically been completed and special consideration has been given to the ladies in arranging this feature of the convention. Friday morning, October 29, members of the association will be taken in automobiles on an inspection trip to Lower Otay Dam and other points of interest on the San Diego Water System. The City of San Diego will be host at luncheon at the Lower Otay Filter Plant. The party will return to the hotel at 4 o'clock. The ladies will be invited to participate in this excursion.

Special entertainment for the ladies, however, is scheduled for Thursday afternoon and evening as well as on Friday.

A steamer trip on San Diego Bay is being arranged for Thursday afternoon and a theatre party for the evening. Friday, the ladies who do not elect to make the Lower Otay Dam trip will be taken in automobiles on a sightseeing trip through the San Diego parks and to Point Loma.

Friday evening, commencing at 6:30 there will be an informal dinner dance in the banquet room of the San Diego Hotel with the manufacturing interests acting as hosts.

C. B. JACKSON

President of the California Section of the American Water Works Association, who will lead members of the section in the descent on San Diego for the annual meeting, beginning October 28.

The program, in detail follows:

Thursday, October 28

Forenoon, 10:00 A. M.: General Get-together Registration and Review of Exhibits.

Afternoon, 2:00 P. M.: Address of Welcome by Hon. John L. Bacon, Mayor of San Diego.

2:15 P. M.: "Description of the Impounding Works of the San Diego Water System" by R. C. Wueste, Supervisor of Impounding System, San Diego Water Department (Questions).

2:45 P. M.: "The Biological Control of Impounding Reservoirs" by Dr. Carl Wilson, Director of Biological Laboratory, Bureau of Water Works and Supply, City of Los Angeles (Questions).

3:15 P. M.: "Report on Water Meter Maintainance Methods" by J. H. Flagg, District Manager, Pacific Gas and Electric, San Joaquin Division, (Discussion).

4:00 P. M.: Five minute papers and discussions.

Evening, 6:30 P. M.: Informal Dinner, Banquet Room, San Diego Hotel. Business meeting; Report of retiring officers; Report of committees; Election of new officers; Selection of next place of meeting. Address by William Mulholland, chief engineer of the Department of Public Service of Los Angeles on "The Colorado River Project."

Friday, October 29

Forenoon, 10:00 A. M.: "Progress in Electrolytic Chlorination at Sacramento Filtration Plant" by Harry N. Jenks, sanitary engineer, City of Sacramento (Questions).

10:30 A. M.: "Corrosion Problems of a Water Supply System and Methods of Protection" by E. B. Stewart, electrolysis engineer, East Bay Water Company, Oakland (Questions).

11:00 A. M.: "Equitable Charges for Automatic Sprinkler Connections" by Major William Cartwright, automatic sprinkler engineer, National Board of Fire Underwriters (Questions).

11:30 A. M.: Five minute papers and discussions.

Afternoon, 2:00 P. M.: "Underground Waters and Pumping Therefrom" by George W. Trauger, superintendent, Lindsay Strathmore Irrigation District and Edmund K. Barnum, engineer, Fresno City Water Corporation. Presented by Mr. Trauger (Questions).

2:30 P. M.: "The Duty of Water in General Municipal Uses" by Charles Lee, consulting engineer, San Francisco (Questions).

3:00 P. M.: "Iodine in Drinking Water" by C. G. Gillespie, director of state board of health, Bureau of Sanitary Engineering (Questions).

3:30 P. M.: Five minute papers and discussions.

Friday, October 29

Evening, 6:30 P. M.: Dinner Dance, Informal, as guests of the Manufacturers in the banquet room, San Diego Hotel.

Saturday, October 30

Morning, 10:00 A. M.: Leaving San Diego Hotel promptly at 10:00 A.

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The EDITORIAL

MODERN Irrigation

Published Once a Month
AT LOS ANGELES, CALIFORNIA, BY THE
PETROLEUM WORLD PUBLISHING CO. *Editorial and Executive Offices, 626 South Spring Street, Telephone Broadway 3262.* Branches: SAN FRANCISCO—447 SUTTER STREET, *Telephone Garfield 2772;* H. E. TAYLOR, *Manager.* CHICAGO—1163 MONADNOCK BLDG., *Telephone Wabash 8855;* JOSEPH E. O'CONNOR, *Manager.* NEW YORK,–56 W. 45TH STREET, ROOM 1105, *Telephone Vanderbilt 3672;* WERNER HAUPTLI, *Manager.*

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By Annual Subscription in the United States and possessions, $2.00; Foreign, $2.50; Single copies on sale in the irrigation country, 20 cents. In ordering change of address, give both the old and the new address. Allow ten days for re-entries on the subscription list. Advertising rates and circulation data upon request. Checks should be made payable to Petroleum World Publishing Co.

Vol. II AUGUST, 1926 No. 8

Conceal the Prop

THE other day a friend of ours came to us and said that he had been offered a position of responsibility, with a salary considerably greater than that he was then receiving, by a recently established concern in which he had considerable confidence. On the other hand, he likes his present work and it pays him a good living. The lure of greater remuneration was pretty strong, but there was just one thing that bothered him about the new job, and that was—whether the concern would weather the storms of the first few months of its existence.

So he had devised a scheme that he intended to put up to his present employer: namely, he would ask for a leave of absence in order that he might try out the new position; and to protect himself, as he thought, he would ask that his present employer take him back into the fold, should this new business fail to succeed or should he, himself, "fall down."

Obviously, this man is entering a new field with the wrong mental attitude and the chances are somewhat against his attaining any considerable measure of success, because, always in the back of his mind will be the thought that if the new job does not turn out well he can go back to the old one.

While the cases are not, exactly, analagous, the plan of our ingenious friend calls to mind the basis on which land settlement is conducted in this country and the impetus it gives to failure because of the plan of financing which makes it possible for the settler to lean on Uncle Sam for help when his bank account runs low. One of the basic characteristics which makes for man's success is self-reliance, and this system, like the plan of our friend referred to above, does not make for a self-reliant worker. A speaker at the recent annual meeting of the Washington Irrigation Institute expressed the situation aptly when he said, "If you hold before men constantly the spoon of public aid, they will always want to eat from it; and in so doing, you will undermine the self-reliance of the people with whom you deal."

GRANTING that it is wrong to give aid to the settler in a way that will undermine his self-reliance, what can be done to give aid where it is needed without destroying this all-essential requisite to man's success? The same speaker referred to in a foregoing sentence suggested that provision be made that only self-reliant, sturdy men and women be given the right to settle on government projects. Some defects could be found in this plan, and in particular it might be said that even were there some mode of determining who should and who should not be permitted to settle, the present system of government aid might easily destroy the quality of self-reliance which a man possessed on taking up the task of making his living from the soil.

Government aid has been necessary; and there have been many worthy cases where well-equipped, intelligent farmers have suffered losses due to crop failures, poor markets and other unforseen conditions. So really, government aid should not be condemned, as a blanket proposition, but rather the method by which it is administered.

Someone has suggested that direct relationship should not exist between the settler and the government in financial dealings; that such transactions should be made through a third party, preferably a private banking organization of some sort. We do not propose to suggest any plan that would, on the face of it, have the ear-marks of a workable scheme, but we do believe that any system which would make it more difficult for the settler to obtain direct aid from the government, thereby increasing his self-reliance, would be a good step in the direction of more successful land settlement. There has, undoubtedly, been a too general and perhaps prejudiced method in working out the government's relief program, and this, because of its psychological effect on the settler, may have been a prominent contributory factor in the distress manifested on certain western projects in the last few years.

Any system which will *compel* the settler to hew his own way, by making it more difficult for him to secure aid, would be a move in

POINT *Of* VIEW

the right direction. The government should bear in mind this one thought in dealing with the settlers; that is, if there is anything that makes a man a man, it is his ability to stand alone, on his own merits, without a prop to fall back on in case the going gets a little tough.

The "Waterworks" Issue

THE October number of MODERN IRRIGATION will be the *first annual water works issue.* But it will be more than a waterworks issue.

While containing the usual variety of editorial material, touching upon hydraulic and irrigation subjects of every sort, it will place especial emphasis upon the important problems of domestic and industrial water supply and upon the peculiar relationship which—in the west, at least—these matters bear to the whole field of irrigation, reclamation, drainage, flood control, and allied activities.

IT WILL, moreover, be an Annual Convention Number; since it will commemorate the annual convention of the American Water Works Association, California Section, which will be held during October at San Diego, California, attended by waterworks men from the National headquarters of the organization and from other parts of the West. It will, therefore, contain a full resume of western waterworks activities, progress reports, technical papers, etc., covering the entire preceding year. Much statistical and engineering data, of permanent reference value, will be included, as well as portraits of the officers of the California Section and other leaders of the waterworks industry in the West.

As this will be the one big opportunity of the year for the waterworks supply firms, who will publish their announcements in the advertising columns of the Waterworks Number, the issue bids fair to be a fairly complete "Who's Who" of both the waterworks industry proper and its allied equipment and supply industry. Many reservations for space have been made, already, and others are coming in daily. In one sense, the October issue will be a "waterworks convention" itself—on paper.

But it will be more than an annual waterworks issue and more than a Convention Number. For in this issue will be included the first publication of "Western Waterworks," the new journal of the waterworks industry of the western states; a magazine within a magazine, in short, but published as a special supplement to MODERN IRRIGATION.

WESTERN WATERWORKS is the logical answer to a need, long felt, for a strictly *Western* publication of the waterworks industry.

Because the western water companies, as well as city water bureaus and departments, are operating under conditions peculiar to the West; and because, as the magazine of all applied hydraulics, MODERN IRRIGATION is concerned directly with the same problems of water development and conservation that affect western municipalities, irrigation systems, and hydraulic enterprises of every kind, it is most fitting that this magazine should carry a section expressly devoted to the problems and activities of this important allied field.

The idea of a "magazine within a magazine" is not new. Its practical application, however, is dependent wholly upon conditions which, in the case of MODERN IRRIGATION, are quite unique. The combination is, indeed, ideal, since it results in a larger and stronger publication for all of its readers, having a general appeal to everyone interested in water matters and a still stronger specific appeal to those who are concerned, more directly, in the practical problems of domestic and industrial water supply.

Many advertisers, too, are thus enabled to obtain direct coverage of a most important market not heretofore served by any medium; while still others, selling the general hydraulic field, are able to kill two birds with a single stone. From the standpoint of practical publishing, therefore, as well as from that of practical advertising, the idea is exceptionally sound and already has met with a hearty acceptance upon the part of readers and advertisers alike.

Is It Worth It?

REPORTS emanating from Washington, state that the Secretary of the Interior has found, on a recent trip of inspection of reclamation projects, that revision of policies dealing with Federal reclamation have brought an era of good feeling and prosperity throughout the west.

We are told that this "era of good feeling" has been brought about by legislation adjusting payment of Federal projects and that over $14,000,000 has been charged off from the different projects for unproductive land as a definite loss. Reading further, we find that another $13,000,000 has been suspended as a probable loss. This, we are told, has produced a new spirit of confidence among the settlers, who have again entered into the cultivation of their farms with renewed vigor.

It is good to have this new "era of good feeling" on certain western reclamation projects, but the fact must not be lost sight of that somebody must pay these losses of $14,000,000 and $13,000,000, and ostensibly the loser is the government, which is just another way of saying the 115,000,000 people in these United States. The question resolves itself into whether it is worth $27,000,000 in this particular instance to the people of this country to put the settlers on crippled reclamation projects on their feet. We hope that it is worth while, because $27,000,000 is a good deal of money and the settlers are going to have to do some tall hustling to justify its expenditure on their behalf. After all, the mental attitude of the farmer is what is going to count the most in working out this land settlement problem.

Service and Reputation Stressed at W. I. E. A. Bi-monthly Meeting

Irrigation Equipment Men in Banquet-Get-Together Discuss Irrigation and Waterworks Industries; Well Driller Gives Suggestions on Proper Installation of Pumps; Balancing Reservoirs Discussed

By DOUGLAS G. McPHEE

TORQUES, casing, velocities, accelerations, revolutions per minute, and peak demands were *en rapport* with the humorous adventures of Sandy, Pat and Abie, at the banquet which followed the bi-monthly business meeting of the Western Irrigation Equipment Association, at Stockton, California, July 30. Good humor and serious discussions of technical problems affecting irrigation's Service of Supply followed an abundant meal served at the Wolf Hotel at seven in the evening.

About seventy-five equipment men and others interested in the equipment phase of the industry gathered at the table.

J. E. Lundy, manager of the Sterling Pump Works, of Stockton, was chairman in charge of arrangements and served also as a competent master of ceremonies, introducing as the evening's toast-master Professor C. L. White, head of the department of engineering of the College of the Pacific.

After the adventures of sundry comical individuals of Hebrew, Hibernian and Caledonian extraction had been fittingly celebrated in song and story, as the lighter part of the evening's entertainment, the banqueteers turned to more serious concerns, and listened with interest to E. K. Barnum, chief engineer of the Fresno City Water Corporation, whose subject was "Balancing Reservoirs for Meeting Peak Demands," and who supplemented this paper with some practical suggestions for keeping track of pump efficiencies. His contribution to the program was illustrated by lantern slides which presented the results of his studies in graphic form.

C. B. Jackson, president of the California Section of the American Water Works Association, spoke briefly of the interdependence of the water works and irrigation industries, and the mutual interest which each should have in the other. Recounting the monumental progress which pump irrigation has made in the West since the first switch was closed to connect electric power with a device for bringing water from the ground (a ceremony at which he was present in 1899), he forecast still greater progress for the two great pumping industries of the west.

A. K. Flynn, well driller, of Orange Cove, California, representing a class of membership of the Western Irrigation Equipment Association which continually manifests a loyal interest in all of its activities, discussed a major problem in which well drillers and equipment dealers are mutually interested. He spoke without notes, and the following account is not a *verbatim* transcription, but merely a summary of his remarks.

"Well drillers serving the irrigation industry, and to an almost equal extent the manufacturers of and dealers in irrigation equipment, are interested in the advancement of standards and the standardization of practices in well drilling, in an attempt to eliminate the chaotic and unsatisfactory conditions which have prevailed too often in the past.

"The greater part of the troubles of drillers, and a large part of the problems facing equipment men as well, have come from the activities of men, calling themselves competent drillers, who have been without the needful experience, or the required capital, or the ethical honesty, to do good work.

"You men who make and sell pumps have discovered that any good pump, whether turbine or plunger, will last and give satisfactory service for an indefinite time if it is properly installed on a straight hole, on which it does not have to pump large quantities of sand. You have found that when the hole is well drilled, nine times out of ten your pump gives unimpeachable satisfaction, it pumps no sand, your customer is well pleased, and the amount of servicing required is reduced to a minimum. Under such conditions it is possible for you to be assured that the profit made on the sale of the pump is a real profit, which will not be dissipated in continual servicing or delayed collections.

"On the other hand, the same pump, if the well is poorly drilled, will yield results of quite a different kind. Suppose the well has been drilled for fifteen or twenty cents less per foot, and the driller has landed casing in the wrong formation, or has used the wrong sizes of casing for the conditions encountered, your pump will bring out literally carloads of unnecessary sand. You find that it operates satisfactorily for only a few weeks. The farmer, naturally dissatisfied, comes back on the pump dealer for satisfaction. He will not usually go to the well driller, for he has paid the driller for his services, but the pump is being bought on time, and the dealer is the natural object for his complaints.

"In such a case the dealer may lose his entire profit, or he may lose his good reputation in that vicinity, and very often he will lose, or at least injure both.

"The only remedy for such a condition is for the farmer and dealer to insist that only competent drillers be selected for these important tasks. The usual way the farmer goes about such a thing is to interview the driller first, to find out what it will cost to drill the well. Having received this estimate, he goes to the dealer for prices on a pump.

"The dealer should know the drillers who are competent to do the job right, who are honest enough to keep an accurate log of the well and to supply copies of this log to the farmer and the dealer. And the dealer should recommend such men, at the same time pointing out in emphatic fashion the advantages of having the well drilled by able, honest experts.

"If the dealer will do this, he will save himself great loss and the farmer a grave disappointment. And although in some cases the cost of drilling will be higher, the cost of satisfaction will be much less.

"The lessons which have been learned in well drilling have indicated that a well driller, in order to be safe for the dealer to recommend, must have had at last five years of experience, and equipment worth several thousand dollars. The dealer can not afford to entrust his reputation to a man who has less preparation for such work.

"There is a responsibility on the dealer, therefore, to find out who are the men he can safely recommend. He ought to induce these men to associate themselves with the W. I. E. A., for their mutual interest, because in so doing they will benefit themselves, the farmers and the dealers. The purpose of this association is to formulate uniform rules, to give the drillers opportunity to exchange experiences, and to advance better practices of common problems.

Drillers' Problems Come in for Large Share of Discussion at W. I. E. A. Business Meeting

R. R. Van Ness of San Jose Heads Committee That Hopes to Bring Light Out of Darkness on Several Questions; Pumps Data Book Ready Soon; Fletcher Honored

By H. ELLIOTT TAYLOR

WELL drillers and their problems occupied the floor during the greater part of the regular bi-monthly business meeting of the Western Irrigation Equipment Association, held in the Hotel Wolf, Stockton, California, July 30.

Members of the association engaged in this particular field of endeavor have long felt the necessity of concerted action on some of their many problems, and accordingly this first opportunity for them really to get together in some numbers was greated with a good attendance; and once under way, the discussions were spirited and to the point, resulting in the appointment of a committee, headed by R. R. Van Ness of San Jose, veteran driller, who will make specific recommendations for action on questions brought up for consideration.

Lack of Uniformity

Short informal talks by several drillers in attendance indicated that there has been a decided lack of uniformity in classification of drilling equipment, as far as the California State Highway Commission is concerned. And this, combined with broad and varied interpretations of the laws by various county and municipal officials has created a complicated and unsatisfactory situation in many instances where the drillers have come in contact with these lesser officials.

In the matter of licenses, to cite an example: In some localities the drilling rig, if it moves under its own power, as many do, is classed as an automotive vehicle of the same status as a motor truck; and a motor truck license is required. Then again, the rig may be classed as a trailer, requiring also a license, but smaller fee. Or it is possible, and has happened, that it is listed as an implement of husbandry and, as such, may move over the state and county highways tax exempt.

To secure some uniformity of interpretation of the state motor vehicle laws to drilling equipment is the avowed purpose of the drilling interests.

Urge Keeping of Well Logs

Beneath the surface, geological formations and the location and depths of water tables in various localities are both of paramount importance, not only to the drillers, but to the argricultural interests as well. Accordingly, it was urged by several speakers that a plan be devised whereby drillers in any territory would keep an accurate log of the various strata encountered in their well boring operations, and the depth at which water was encountered. While it was pointed out that there is a wide variation in conditions encountered even in a restricted area, it seemed to be the concensus of opinion, that to have data available would be of considerable value to the driller. The feasibility of keeping logs of drilling wells and providing some central clearing house for the information is another one of the knotty problems that confront Mr. Van Ness and his committee.

C. F. ZIMANSKY

Mr. Zimansky is bringing to a close his second year of service as president of the Western Irrigation Equipment Association, progressive trade organization of the equipment men on the Pacific Coast. The annual meeting of the association is scheduled for September 8 at the Sacramento (California) Fair Grounds.

The final question of major importance, as far as the drillers are concerned, was the consideration of the necessity or advisability of devising a uniform drilling contract. It was pointed out that there are a great variety of contracts and agreements now in use, and an attendant amount of misunderstanding on many finished jobs. Speakers indicated that the contract form should provide special compensation where the driller encounters solid rock or boulders. Other conditions and specifications that might be incorporated in any standard form of contract, should one be evolved, are to be investigated by the committee.

Executive Committee Meets

The customary meeting of the executive committee was held in the morning, when affairs of the internal arrangement of the organization were discussed, and plans to be presented to the membership were considered.

One of the outstanding actions taken by the committee was the recommendation of the name of Professor L. J. Fletcher for the second honorary membership in the W. I. E. A. The recommendation received the unanimous and enthusiastic approval of the membership, upon presentation before the afternoon open session.

Professor Fletcher is director of agricultural engineering at the University of California's experimental farms at Davis, and has been closely associated with the W. I. E. A. through his position as head of the California committee on the relation of electricity to agriculture.

Afternoon Session

With President Zimansky in the chair and Secretary Utley calling the roll, the regular afternoon session opened at 2:30 with about thirty-five members present.

Several committee reports were heard. The standard form of contract for pumping plant installations will probably be ready for adoption at the next regular meeting, it was reported. A communication was read from the officials of the state fair, in which the pump manufacturers and other distributors of irrigation equipment were urged to participate in this annual event. Efforts of the association notwithstanding, the pump exhibit will be housed in the old tent this year as of yore. But 1927 will, no doubt, see a permanent building con-

(*Continued on Page 53*)

HYDRAULIC ENGINEERING

Dealing with the Practical Problems of the Operating and the Consulting Engineer

Looking at Concrete Pipe Through the Eyes of the Irrigation Engineer

By MILO B. WILLIAMS

Consulting Engineer, California Associated Concrete Pipe Manufacturers

THE first concrete pipe manufactured in California was made by hand-mixing of the materials and was molded in steel forms. The semi-dry materials were tamped into the forms by hand and both the jacket and cores immediately removed. This slow and laborous method had many disadvantages and although miles of hand-mixed and hand-tamped pipe have proved successful under the conditions installed, there was ever present a great many human equations due to the change and fatigue of men, which made it difficult to produce a standardized or uniform product by any one manufacturer or in the industry as a whole.

It is easier to make a good quality, large, rather than a small hand-tamped or air tamped pipe, as coarser materials and reinforcing are used to advantage. Many of our manufacturers still hand-tamp large culvert and irrigation pipe successfully, but use a power mixer on carefully graded materials, of a proper moisture consistency.

The use of concrete pipe for irrigation called for the manufacture of metal irrigation appliances in the way of gates, valves, and tools. This developed irrigation specialty companies, which have perfected power machines for the manufacture of concrete pipe.

Power Machines Described

The power machines now used in California may be divided into two general classes; i. e., the "packer head" type, and the "tamping" type. Both machines produce well-compacted concrete in the walls of the pipe, when the materials are properly graded and mixed with the correct amount of moisture and cement. Both types trowel the inside of the pipe smooth and can build all sizes of pipe from 4 inches to 24 inches in diameter, in 24 to 36 inch lengths. Either tongue-and-grove, or spigot-and bell ends are made. Under proper design of the material-mix, no difficulty is experienced in manufacturing sewer pipe to meet the standard specifications of the American Society for Testing Materials. Double-wall and reinforced pipe can be made on these machines while a few of the machines can be equipped to build up to 36 inch pipe.

Considerable poured concrete pipe is made in California for large sewers, culverts, and water pressure lines. With this method of manufacture, high-carbon steel cages or rings can be used for re-inforcing and a pipe made for pressure heads up to 125 feet. Precast poured sewer pipes up to 102 inches in internal diameters have been built for outfall sewers for the city of Los Angeles.

For High Pressure Duty

The combination of steel and concrete revolutionized the construction of great buildings, and the same combination will ultimately expand the uses of re-inforced concrete pipe into unlimited fields, for the carrying of water under high pressures. I see no more attractive engineering opening than the working-out of adaptable designs, methods of manufacture, and application of concrete pipe to high pressure duty. Costs, carrying capacities, and durability, give concrete pipe many unequalled economic and engineering advantages, and improved methods of maunfacture, together with recent successful control of water surge and water hammer, and the provision for contraction and expansion in high pressure lines, makes certain of an early advancement in these fields.

Hydrostatic pressure in concrete pipe places the walls under a tensile stress. This is an unusual duty for concrete when used in non-re-inforced concrete pipe, as in all other concrete construction engineers place concrete under compression only and introduce sufficient steel to meet the tensile stress. High tensile strengths of 300 to 600 pounds per square inch, and imperviousness in a thin wall, are the two principal qualities sought in concrete pipe, which are also factors indicating good durable materials.

California Manufacturers Organized

Manufacturers of concrete pipe in California caught the vision of standardization, uniformity and quality in 1919, and the California Associated Concrete Pipe Manufacturers came into being with Fred W. Stanley, as secretary-engineer, at its head.

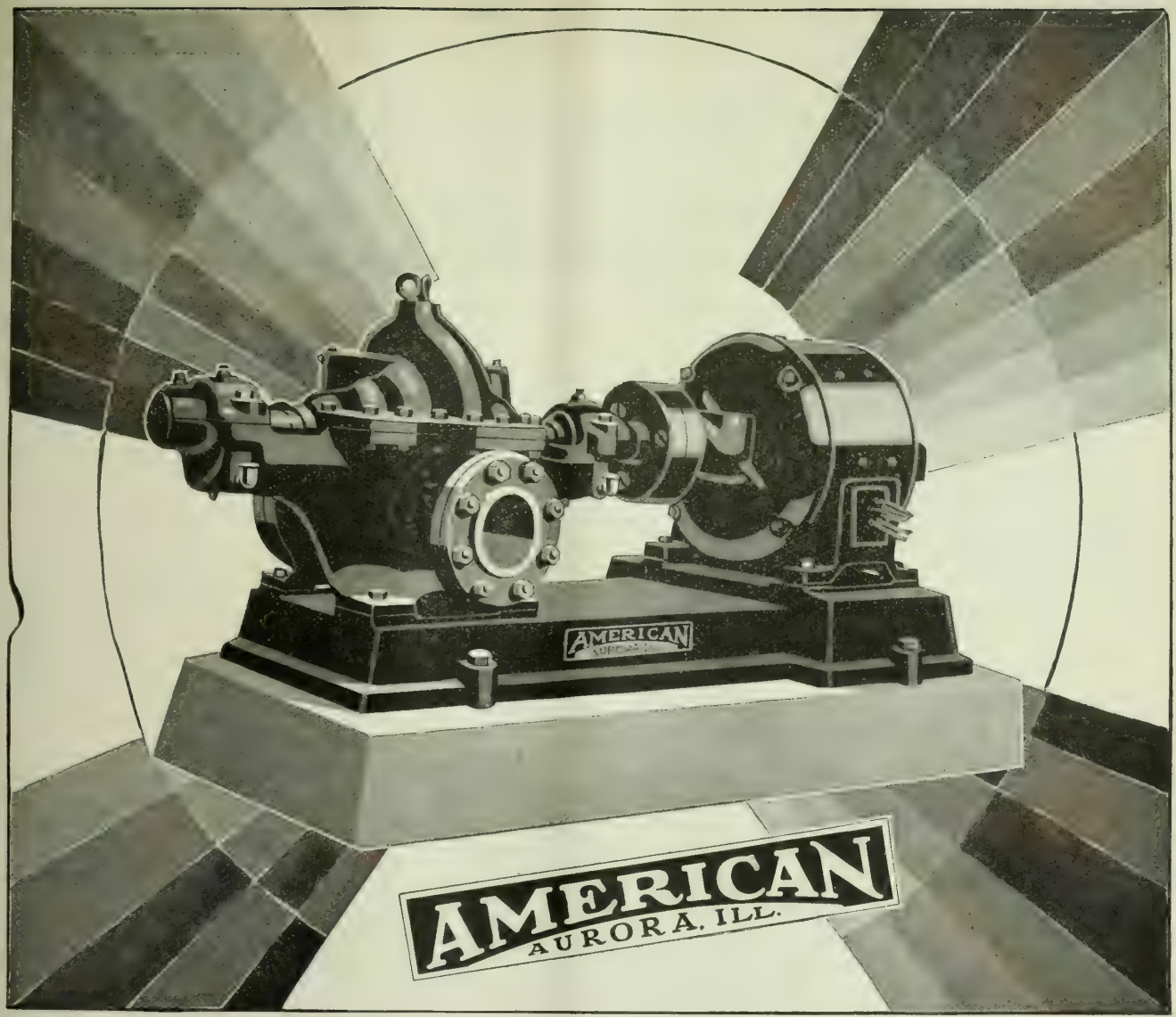
Although Mr. Stanley had become a manufacturer of concrete pipe, the association and the industry lost the hearty support of an engineer of sterling character, who possessed great ability and an intricate knowledge of the fundamentals of concrete pipe design and manufacture, when he met a tragic and untimely death last May.

The California Associated Concrete Pipe Manufacturers has been a going institution since its birth and its duties are to hold a rapidly growing industry in balance. The association is not a price-fixing organization, but a protective, educational and promotional institution.

Engineers' Responsibility

There is only one way for a manufacturer to know the quality of his product, and that is by working to a standardized grading of his materials and continual testing of his pipe.

Engineers can do a great good for the concrete pipe industry, and give a service to the public to the great credit of the engineering profession, by demanding that all concrete pipe installed in their projects not only be made according to association specifications but that the product be continuously tested to see that it is up to the required standards before it goes into the trench. The association will gladly help engineers draw up specifications and assist with testing equipment for the benefit of the industry.



THE "American" type DSMD centrifugal pump is a horizontal split shell, single stage, double suction, centrifugal pump furnished with bronze enclosed impeller, bronze labyrinth wearing rings, bronze shaft sleeves and bronze split glands.

Pump is mounted on extended cast iron base to receive motor and is provided with flexible coupling of the pin and bushing type for direct connection to motor.

Pump is of the double suction type and is built in sizes from 2″ to 42″ and for designed heads up to 250′ depending upon size and capacity.

The bearings of the pump are entirely separate from the stuffing boxes which eliminates the possibility of any grit or water in the bearing. The oil reservoirs in the bearing are large, furnishing an ample supply of oil. The stuffing boxes are water sealed so as to insure tight packing without excessive pressure for friction on the revolving shaft.

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THE HYDRAULIC DIGEST

A Monthly Bulletin Board of Brief Facts and Events from Far and Near

Pipe For Golfers

The Pacific Pipe Company, San Francisco, has practically completed the furnishing and installation of the pipe for the Oak Knoll Golf Club, said to be one of the finest on the Pacific Coast, and is about ready to start on two other eighteen hole courses, all using "Pacific" pipe.

Ventura Will Vote On Bonds

The city board of trustees of Ventura, California, recently met and decided to call a bond issue election for $250,000 worth of bonds with which to improve the city's water system. The exact date of the election will be set at the August 9 meeting of the board.

More High Line Canal

A call for bids for the construction of a 10-mile section of the main canal of the Kittitas High Line will be issued next month, it was stated in Yakima recently by Dr. Elwood Mead, commissioner of reclamation, adding that $2,000,000 will be spent on the project this year. The sum of $2,750,000 is available.

Pecos Wins Battle

Pecos, Texas, and the valley beyond, recently celebrated the successful conclusion of fourteen years of fighting to obtain a reservoir which will impound water sufficient to irrigate the 110 miles along the Pecos river. The Pecos Valley Water Users Association has led the complicated battle which ended last month.

No Colorado Weir Yet

The annual construction of the summer weir to halt the low flow of the Colorado river during the dry season may be necessary in the near future, according to advices received from F. H. McIver, secretary of the Imperial Valley Irrigation district. Permission to construct the weirs across the river above Andrade has been granted by the war department in Washington but the district will wait till the necessity arises before the construction is undertaken.

New Main in Glendale

A new thirty-inch cross-town water main in Glendale, California, that had been under construction for the past four months was dedicated late last month, according to Peter Diederich, manager of the public service department of Glendale. It was said that this new main nearly triples the capacity of the city.

Los Angeles to Vote Bonds

On August 31, the city owners of Los Angeles will be handed a separate city ballot on which they will vote on a new 11,000,000 dollar power bond issue and a new 10,000,000 dollar water bond issue. The ten million dollar water bond issue is for the complete purchase of water bearing lands in the Owens River Valley to add to the city's water supply and for new water distributing trunks in the city and for additional storage facilities. The interest and sinking-fund charges on the bonds will be paid from the water-and-power revenues, as required by the latest city charter.

Pima Farms Irrigation Sold

The transfer of the irrigation system of the Pima Farms company to the Catalina Water Company in return for 350,000 shares of the capital stock of the latter comapny was authorized recently by the Arizona corporation commission. At the same time the commission issued an order granting the Catalina Water company a certificate to operate a public water utility for irrigation, and authorizing the sale of $500,000 worth of first mortgage, 7 per cent gold bonds. The authorization of the delivery of 350,000 shares of capital stock of the Catalina company to the Pima Farms was also made.

Imperial Irrigation Damages

Award of 114,000 dollars damages against the Imperial Irrigation District was announced late in July by arbitrators for land fringed by the Salton Sea and near the mouths of the Alamo and New rivers. These lands were injured according to the claims, by excessive flow from the Alamo and New rivers some two or three years ago. By the award, it is said that the Imperial District acquires an easement right to use the land up to 240 foot below sea level contour for drainage proceedings. Out of the 15,000 acres claimed, about one half had been under cultivation and an additional amount was prepared for irrigation at the time o fthe overflow, it was stated by the claimants.

To Build Power Project

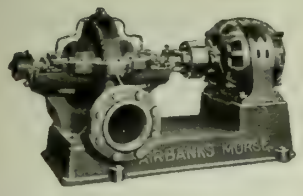
Application for 20,000 acre feet annually from the Tuolumne River and Moccasin creek in Tuolumne county for a power project involving expenditure of approximately $5,574,000 was filed with the State Division of Water Rights by R. V. Meikle, chief engineer of the Turlock irrigation district.

The Turlock district, Meikle's application explains, proposes to build a dam and power plant several miles above the tail water of the Don Pedro dam, from which the ditsrict now draws its irrigation supply.

Diversion of 1200 cubic feet a second is contemplated. A total of 27,000 theoretical horse power is to be generated by means of three turbine water wheels of 9000 horse power each.

Long Beach Improvements

The successful completion of the water development program mapped out for Long Beach, California, by the municipal water department for the coming fiscal year will cost approximately $1,500,000, according to Clark H. Shaw, Long Beach water superintendent. Paramount among the developments to be sponsored will be the development of more new wells in Long Beach proper and in the newly annexed property, especially Virginia City. The construction of more and larger water mains will also be taken into count. It is said that a new storage reservoir will probably be completed that will have a capacity up to 50,000,000 gallons. Mr. Shaw has suggested that a bond issue be floated to carry the expense of the improvements, pointing out the fact that the revenue from the operation will more than care for the interest and sinking fund charges.



Double responsibility

—its meaning to you

When it's a question of pumping service there are always two things to consider—the driven unit and the driving unit. One is dependent upon the other.

Many irrigation farmers who are using F-M pumping equipment were influenced by the fact that they could obtain from Fairbanks-Morse a pumping unit in which both motor and pump were built together and backed by one manufacturer.

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An Industry on Desert Sands

(*Continued from Page 16*)

ing of the tree crops already mentioned. Without fertilization, also, the successful raising of crops such as sweet potatoes, peanuts, melons, alfalfa, etc., would have been impossible.

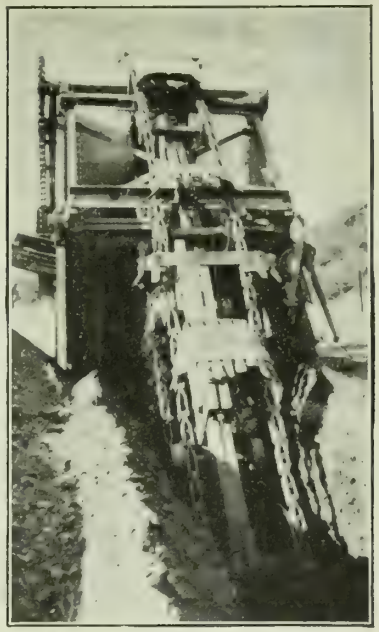
The company, therefore, very early decided to combine animal husbandry with the raising of tree and small crops, and in line with this policy have established their poultry plant, which is one of the largest and most successful in the State, and under the name of the Southern Livestock Company have established and are now operating what is probably the largest hog ranch under one management in the world. The fertilizer from these plants, and also from the barns at the numerous camps where the farm operating force have their headquarters, has all been used in the soil, whose fertility will now compare favorably with any in California, whether developed from naturally fertile soil or built up out of the desert sands.

A brief description of the poultry plant and the policy of the company in encouraging poultry raising on the tract will illustrate the thorough manner in which all of their various operations have been undertaken. It was early realized that citrus culture and poultry raising practiced together on the same land is an almost ideal combination, and that natural advantages existing on this project made an advantageous place in which to practice it. Citrus trees require a large amount of available nitrogen and phosphates for a rapid and productive growth, and poultry manure is ideal for the purpose of supplying this material. The orange trees furnish shade for the poultry and beautiful setting for the residence of the poultry owner.

Poultry Forms Corner Stone

A great deal of attention was given in the early years of the industry on the project to the design of the poultry houses and the appliances to use therein, that would be best adapted to commercial poultry ranches for this climate. As finally evolved these houses all front south, being high in front to admit a good supply of sunlight, and are equipped with movable awnings on the south side to keep out wind and rain. The houses are all built on concrete foundations with concrete floors. The entire arrangement of nests, perches, hoppers, etc., enables the operator to do the greatest amount of work with the smallest amount of labor.

(*Continued on Page 34*)



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Public Service Ditcher, Model 21, owned by the United Concrete Pipe & Construction Co., of Merced, Calif. The above view shows the machine in operation on the 20,000-acre Guenoc Rancho near Middletown, Calif.

Side cutters built in the field and installed on the machine, as shown below, give increased width to the ditch—from 24 to 34 inches. Any width within reason can be obtained by this method.

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IRRIGATION MANAGEMENT

State Engineer Looks to Colorado River as Added Source of Domestic Water Supply for Southern California

STARTED by the late State Engineer, W. F. Mc Clure, an extended report was recently made by the present State Engineer, Paul Bailey to Governor Friend W. Richardson. The full text of the report, to the California governor on "Water Supply of Southern California," follows:

In assuming the duties of Acting State Engineer under your recent appointment, may I submit to you the first of several progress reports upon the status of current work in this office.

As you know, Southern California contains 20 per cent of the lands of the State that are favorable for human habitation, while but little over 1 per cent of the State's waters are tributary thereto. Although possessing a disproportionately small share of the State's waters, these lands have experienced a rapidity of settlement and improvement that has amazed the entire world. Already one-fifth of the area possessing a water supply lies within the incorporated cities and towns and this fraction is continuously growing larger. The relinquishment of agricultural land for urban use does not reduce the total water consumption, as cities of fairly mature growth use water in amounts about equal to that required for irrigating the same area. The demand for water, therefore, can never grow less in Southern California, but rather, larger supplies will be needed for industries and manufacturies within cities and for the extension of agriculture to the limits of the available lands.

Mono Lake Waters

In arriving at the present great development in Southern California, less than half of the favorable area is occupied by cities or towns and irrigated lands. To reach this stage of development, nearly the entire supply of local water has been brought into use. Since an adequate water supply is requisite to growth, the salvation of Southern California is to seek a distant source of supply. Relief from the pending exhaustion of local waters was temporarily obtained by the importations from Owens Valley by the city of Los Angeles. Some further relief could be obtained by extending this project to include the waters from Mono Lake region, but this would be sufficient to satisfy the growing demands for only a few years. The one supply that can adequately meet the future needs, that is not separated from Southern California by insurmountable physical barriers, is the Colorado River.

The paramount need in Southern California, therefore, is water from the Colorado River. This is vitally necessary for the continued growth and prosperity of the entire south, from Ventura to San Diego and from Los Angeles to the Imperial and Palo Verde valleys. It is of primary importance to the entire State of California that the growth of this wealthy region should never be arrested by the lack of water. Likewise the protection from floods in the Imperial and Palo Verde valleys and other areas along the Colorado is of State-wide concern, for these sections have become important units in the economic structure of the State.

In conformity with your desire for an intelligent and orderly procedure in the solution of all State problems, this office has been engaged for the past twenty months in making the investigations necessary to reach sound conclusions concerning the relation of California to the Colorado River. Not until the city of Los Angeles declared its need for Colorado River water has this river ever been considered as available for lands other than those immediately adjacent to the river itself. The studies by this office of the water resources of the State, however, indicate that there exists a vital need, not alone for the city of Los Angeles, but for the entire southern end of the State. The urban and suburban areas are developing so rapidly that domestic and industrial water will be needed beyond previous conception. Much of this water will be needed for irrigating agricultural lands adjacent to the cities, but the present rapid relinquishment of agricultural lands for occupation by cities and towns indicates an ultimate municipal and domestic use for a very large amount of water, much more than local sources can supply.

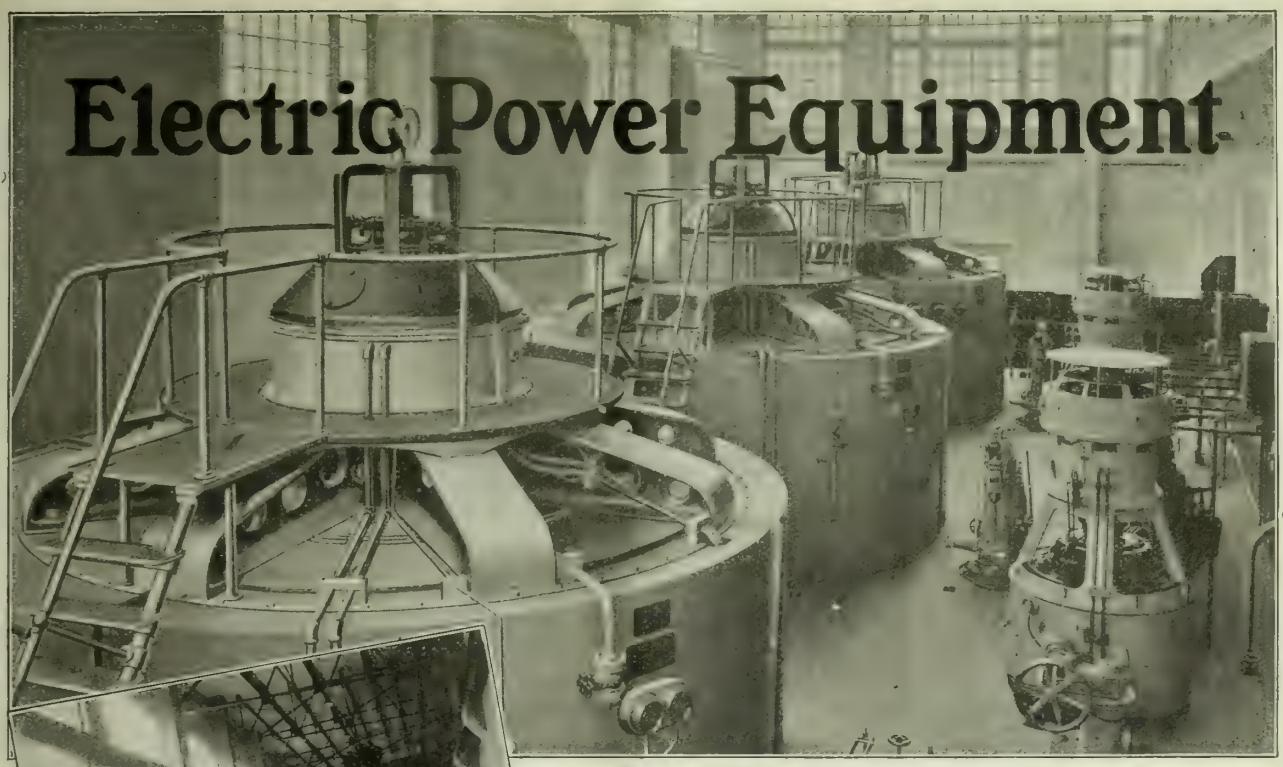
Such a large undertaking as diverting the Colorado River into Southern California can obviously be accomplished by many different plans with widely varying costs, any one of which will cost millions of dollars. It is vitally important, therefore, that the most economic plan be evolved, for otherwise there is danger that the cost will result in stifling tax burdens.

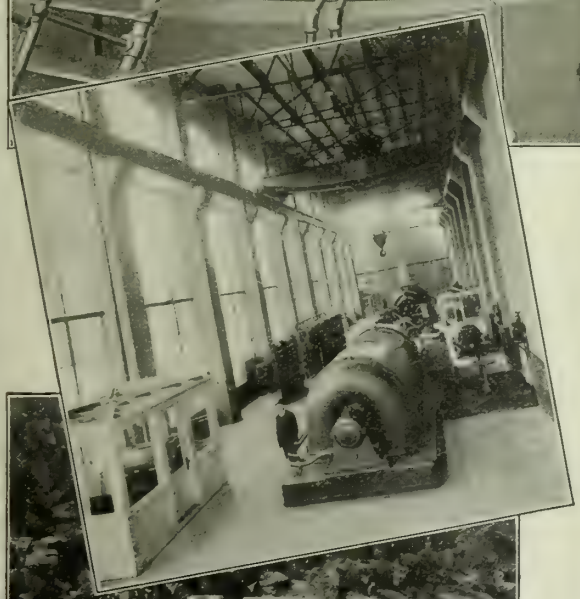
Costly Undertaking

For these reasons, the efforts of this office in preparing a co-ordinated plan for the development of the State's waters as directed by the Legislature of 1925, have been centered upon, first, the determination of the volumes of water required from a distant source for every section of Southern California in order to accomplish the full development of their natural advantages and, second, the determination of the most economic plan for storage of Colorado River water and its diversion to each area. Included in these studies are means for controlling floods on the lower Colorado River and the development of the largest amount of incidental power possible. It is not regarded at the present time that the development of power alone on the Colorado River is of such immediate importance to California as the development of water, for it has been pointed out in the report of Messrs. Butler and Ready to the Los Angeles Chamber of Commerce that the power from the Boulder Canyon Dam could only be absorbed by California markets through the abandonment of other construction programs by the city of Los Angeles and the Southern California power companies. The great immediate value of Colorado River power is limited to the extent that structures, required by the water development program, may be made to do double service by developing incidental power.

The first step in carrying out this program was taken in November, 1924,

Electric Power Equipment





For the power plant, complete equipment "from prime mover to switchboard" is built by the Allis-Chalmers organization. This includes all types of prime movers—steam turbines, hydraulic turbines, steam, gas and oil engines, together with complete electrical equipment. Condensers of all types, pumps, air compressors and many other auxiliaries are also supplied. Allis-Chalmers equipment is used in plants of all sizes, and includes some of the largest power units ever built.

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when the writer personally went in the field to investigate possible diversion routes from the Colorado River to all sections of Southern California. The particular effort of this search was to locate a direct route from Boulder Canyon into Southern California, so that the diversion could be made at the elevation of the water surface in the reservoir, the highest possible elevation of diversion, and so that only water desilted by settlement in the reservoir would be taken into the conduit. Such a direct route from Boulder Canyon was found. This route would harmonize with the present proposals for the construction of a dam at Boulder Canyon, now being publicly considered. It would also serve not only the Los Angeles metropolitan area but all sections of Southern California from Ventura to San Diego as well. Since finding this route, the writer has spent a month or more in the field studying these possibilities and directing the efforts of assistant engineers.

Engineers Conduct Investigation

In order to make the work of this office of the highest value to the public, a group of consulting engineers has been associated with these investigations. They are all men so well known in engineering circles that their names are synonomous with knowledge and sound practice, each in his particular line of endeavor. These men are giving their time to the State for a nominal compensation. Their review of the work of this office insures that the plans matured will be the best the engineering profession can produce. The names of these consultants are William Mulholland, J. B. Lippincott, Louis C. Hill, Walter L. Huber, G. A. Elliott, A. J. Cleary, B. A. Etcheverry, F. C. Herrmann and A. Kempkey. Co-operating in this work and meeting with the consulting committee are also Maj. C. S. Ridley, U.S.A., executive officer of the California Debris Commission; Lester S. Ready, Chief Engineer of the State Railroad Commission, and F. E. Bonner, District Engineer of the United States Forest Service and representative of the Federal Power Commission in California. This entire committee has spent nine days in the field studying the Colorado River problems.

Extensive Program Planned

The program of investigations as herein outlined, although it includes only the features of the Colorado River development that pertains to the needs of California, is nevertheless so extensive that its successful completion in time to report to the 1927 Legislature as required by the statute authorizing the work, would not be possible except for the very hearty co-operation of the city of Los Angeles. The water department, under William Mulholland, manager and chief engineer, has extended every aid within its power in making these studies. Its work in preparing plans for an additional water supply for the city of Los Angeles has produced maps of practically the entire area between the city and the Colorado River. All these have been made available to the State without cost.

The investigations and surveys made by the United States Reclamation Service and the United States Geological Survey on the Colorado River provide data on the reservoir and dam sites along all sections of the stream and much information on the water supply.

With this information as a start, the survey for transporting the Colorado River water to the Pacific slope of Southern California has proceeded. A close examination has been made of all the physical features along possible routes. Alternate designs and estimates are being prepared.

Other studies concerning the water supply of Southern California are also under way. A large portion of the present water supply of Southern California is pumped from underground basins. The continual sinking of new wells in recent years has caused a serious lowering of the ground water levels in nearly all sections. This office is now finishing the first complete survey of the underground waters of Southern California. This will show the recession of well levels and the depletion in all the subterranean basins during the last four years.

Also, in co-operation with Orange, Riverside and San Bernardino counties, this office is preparing a plan for the complete conservation and control of the Santa Ana River. As in the Colorado River investigations, the Santa Ana work is proceeding in consultation with engineers particularly well known in Southern California and especially familiar with conditions there. They are J. B. Lipincott, A. L. Sonderegger and G. S. Hinckley.

All this work has been diligently prosecuted through the present biennium along with similar investigations in the remainder of the State, with the end in view of having a report covering the entire subject of the conversation and control of the State's waters completed for presentation to the 1927 Legislature as provided for by statute.

White Signed by Bucks Creek

Ross White, formerly resident engineer, Merced Irrigation district, has accepted the position of resident engineer on construction of the Bucks Creek project of the Feather River Power Company.

Announcement

THE FIRST Annual Waterworks Number of MODERN IRRIGATION will make its appearance as the issue of October, next. This issue will carry, as a separate insert, a new section to be known as WESTERN WATERWORKS, dealing authoritatively with this closely allied hydraulic field in the western territory. WESTERN WATERWORKS will be printed on a sepia tinted paper stock, and will become a regular monthly feature, taking the place of the present department entitled "With the Water Companies."

It will be, actually, a magazine within a magazine—the recognized authority upon all matters having to do with the problems of water conservation and development (as they relate especially to domestic and industrial supply) that are so peculiar to the West: the proper clearing house of current information on western water works activities and a Who's Who of the leading supply companies who sell this important and fast-growing industry.

On to San Diego!

The Annual Convention of the American Water Works Association, California Section, will be held at San Diego on October 28, 29 and 30. The October Number (incorporating WESTERN WATERWORKS) will therefore be a *Convention Special* and will cover the year's activities of the California Section as well as other domestic water developments throughout the western territory. If your company sells the water works industry, as well as the irrigation field, or if you sell the water works industry exclusively, *adequate representation in this issue should be of utmost importance;* since the October Number will be received by every worth while water works executive in the west, and will carry the advertising announcements of every representative company handling water works equipment. It will be kept, for technical reference, long after the convention is over.

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WITH THE WATER COMPANIES

Of Interest Expressly to Water Works Engineers, Superintendents and General Managers

The Completion of a Program to Give Water to Two Million People

By DON J. KINSEY

With the Municipal Water Bureau of Los Angeles.

A CONSTANT growth in population and the absence of large water resources near at hand forced Los Angeles twenty years ago to search far afield for additional supplies of this basic necessity of life. The search took engineers for the City to Owens River Valley, and there they found the water so imperatively needed to meet the increasing requirements of their people.

On August 31 the people of Los Angeles will be submitted a water bond issue of $10,000,000 of which $6,000,000 is to be used to carry forward the city's program of purchasing water bearing lands in the Owens Valley. These land purchases, it is explained by William Mulholland, Chief Engineer of the Los Angeles Water Bureau, are necessary to increase and safeguard the Owens River Aqueduct water supply.

Since 1923 the Municipal Water Bureau, of Los Angeles, has been pushing forward its program of water bearing land purchases in Owens Valley. Approximately 80,000 acres are included in the area which either has been or is to be purchased. Of this total acreage, 30,000 acres already have been bought and paid for; 35,000 acres have been purchased and partially paid for, and negotiations for the purchase of the remaining 15,000 acres are now rapidly progressing.

Most of the land being bought by Los Angeles is in the neighborhood of the towns of Bishop and Big Pine, although the purchased area also includes Round Valley, a short distance north of Bishop.

With the city in possession of these lands and the possession of their water rights assured, one of the last steps in the development of this great municipal water project will have been completed, and the Aqueduct will be assured of a water supply sufficient to meet the needs of the people.

As Los Angeles approaches the final stage of development in this gigantic water system, it is interesting to review, for a moment, some of the history and facts in connection with one of the greatest water supply works ever built by an American city.

Owens Valley is situated in the central eastern section of California, its most southerly point being about 200 miles north of Los Angeles. With the Sierra Nevada mountains on the west and the White and Inyo mountains on the east, it is approximately 100 miles in length and varies in width roughly from 5 to 15 miles.

The Valley has a population of about 8,000, including the residents of its four principal towns, Lone Pine, Independence, Big Pine and Bishop.

Down through Owens Valley flows the Owens River, fed by the melting snows of the High Sierras, and finally, unless diverted, it empties into the salt encrusted Owens Lake. It was to secure the life giving water from Owens River that the City of Los Angeles built an aqueduct 250 miles long to tap this source of supply and bring it to the people of this city. The aqueduct was started in 1908 and completed five years later in 1913. Ever since its completion the Owens River Aqueduct has been Los Angeles' main water supply source. Its construction is said to have made possible the present metropolitan proportions of the city; without this water system, it is estimated Los Angeles could never have supported a population of more than 300,000.

Owens Valley

Originally devoted to mining activities, Owens Valley's three principal sources of revenue today are the mountain tourist trade, agriculture, and business growing out of the operation of the aqueduct.

Although the Valley comprises several hundred square miles of territory, only a fraction of the land is used, or ever was used, for agricultural purposes. The greater part of the land is not adaptable to farming either because of the character of the soil or because it cannot be economically irrigated.

For more than twelve years the officials of Los Angeles have been attempting to work out, in Owens Valley, a permanent water policy that would be beneficial not only to the city but to the irrigators of that region.

In 1914 city officials opened negotiations with the irrigators with the view of establishing such a policy. The ranchers asked for time to make certain stream measurements along Owens River. These operations continued until 1921.

In 1921 the city submitted another proposed agreement based on data collected by both the Municipal Water Bureau and the valley ranchers. Under this plan the city offered to construct a 100-foot dam in Owens River Gorge, thus creating a storage reservoir above Owens Valley. This reservoir was designed to be vastly more beneficial to the irrigators in the Valley than to the City of Los Angeles as the city already possessed large aqueduct storage capacity below the ranchers' land.

The majority of the ranchers favored the plan submitted by the city. Others, however, insisted that the city build a dam 150 feet high. The city could not agree to this plan since engineering studies had disclosed that above the 100-foot elevation the walls of the storage basin were so loose and porous in structure that water stored higher than the 100-foot line would be lost through leakage.

When the city started preliminary work on the 100-foot structure the land owners demanding the 150-foot structure instituted injunction proceedings in court, and all the work on the dam was halted.

Thus matters stood until 1923. In that year the southwest was beginning to feel the pinch of a widespread water shortage. Since the ranchers had their

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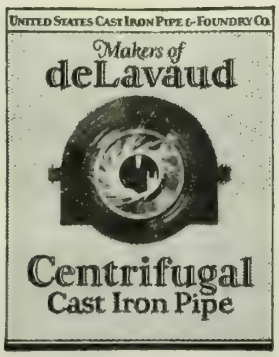

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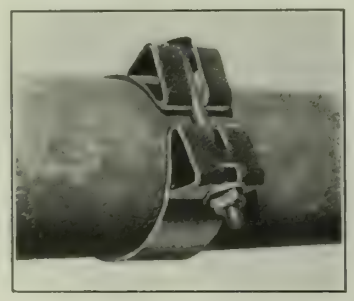

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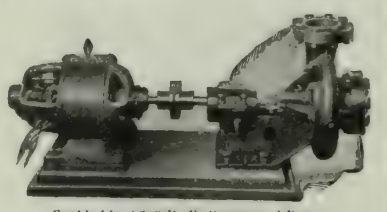

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irrigating ditches above the point on the river where water from that source was diverted into the aqueduct, they had, physically, first call on the water. Consequently the shortage in water would be felt first by the city.

In order to assure an adequate water supply for the people of Los Angeles, the Board of Water and Power Commissioners in 1923 authorized the purchase of lands in the valley with water rights on the river.

The Board of Water and Power Commissioners retained the services of three engineers to make a detailed study of the water resources of Owens Valley with the view of determining exactly how much water, on the average, would be available in that region for ranchers and water consumers in Los Angeles. These three engineers were Louis C. Hill, J. B. Lippincott and A. L. Sonderegger.

In December, 1924, the Board authorized the purchase of all water bearing land along the river in Owens Valley. In order to arrive at figures that would be fair to the land owner, the Board authorized the appointment of a special committee of appraisers. This committee was and is composed of three members, namely: George Naylor, chairman of the Inyo County Board of Supervisors; V. L. Jones, Assessor of Inyo County and Grant Clark, former Assessor of Inyo County.

Aqueduct Brings Prosperity

The construction of the Aqueduct is said to have brought many benefits to the Valley. Prior to the initiation of the city's project, the valley was practically cut off from the rest of California by the high Sierra Nevada mountains, on the west and by the Mojave Desert on the south. Its only communication with the outside world, other than a horse stage operating between Mojave and Keeler—a distance of approximately 120 miles, was a narrow guage railroad extending from Keeler northerly through the Valley and connecting with the standard guage line of the Southern Pacific at Mina, Nevada.

In order to transport the large quantities of freight incident to the construction of the Aqueduct, it was necessary that the city should either construct a private railroad into the valley or induce one of the railroad companies to construct a line which would be a common carrier. Negotiations with the different railroad companies resulted in the Southern Pacific Company's entering into a contract with the city to construct a standard guage railroad from Mojave northerly to Owenyo in the Owens Valley, and to carry the city's freight. This line was constructed and gave the Valley a direct outlet to California points, and is said to have done more to bring about the era of prosperity which has existed in the valley since that time than any other one item.

In 1905, at the time of the initiation of the city's project, Inyo County had an assessed value of $2,487,154. For 1925 the assessed value was $11,031,755. In 1900 the population of Inyo County was 4,377. In 1920, it was 7,031. The town of Bishop had not been incorporated in 1900, so that its population was not separately shown in the 1900 census but in 1905 it was estimated to be 740, and in 1920 its population was 1304.

Better Roads Bring Tourists

The city in connection with the construction of the Aqueduct, greatly improved the condition of much of the road leading from Mojave into the Owens Valley. Its activity also served to advertise the Owens Valley, and these factors have resulted in extensive tourist and pleasure-seekers' travel, establishing a tourist business which is said to have contributed greatly to the prosperity of the valley.

The city's operation gave employment to numerous residents of the valley, and the large working forces maintained there by Los Angeles have contributed to the prosperity of the merchants. The city itself has followed the policy of purchasing in the valley such materials needed by it as were available there. It also paid liberal prices for such property as it purchased, which resulted in placing in circulation in the valley substantial sums of money. The purchasers of lands and water rights made in the early history of the enterprise amounted to more than a million dollars, much of which was paid to residents of the valley and placed in circulation with resulting benefits to the community as a whole.

City is Largest Taxpayer

At the time of the initiation of the Aqueduct project, the State of California Constitution exempted from taxation all municipally-owned property. The officials of Los Angeles, feeling that justice to the valley required that land which had formerly been taxed should not be withdrawn from taxation, voluntarily paid taxes for several years, the collection of which could not have been enforced by any legal process. Los Angeles was also instrumental in obtaining an amendment to the California State Constitution, legalizing the taxation of its lands in the valley. It has ever since paid taxes on all of its property, at the same rate as paid by residents of the valley, till today it is the largest taxpayer in the county. More than $100,000 are said to have been paid in such taxes in the last fiscal year.

Where Good Judgment Pays

(*Continued from Page 13*)

has reached the ends of the furrows.

This is the condition on the lower lying soils, and those that have been under orchard many years, and is due largely to the character of irrigation water used. The water contains much gypsum and but small amounts of chlorides, and the result is a well flocculated soil which does not seal itself up against water penetration. It is common enough on those soils to apply about 8 to 10 acre-inches when only about half that amount, or less, may be called for.

On the other hand, we have hill soils that are quite different, being composed of a decent enough surface soil, but having a very intractable subsoil which does not take water readily, and when it gets too much it does not drain well, or not at all. Those grove areas are handled quite differently in irrigation, needing much longer time during the run of the water and sometimes needing deep chiseling to enable them to take water readily enough.

Overhead Being Tried

We are experimenting with the overhead system of irrigation but our observations have not yet continued long enough to compare that system thoroughly with the furrow system. Lemon fruit measurements on large Lisbon trees occupying about all the available space in the grove showed that the overhead irrigated trees grew lemons about two packing sizes larger than the adjoining trees furrow irrigated, from April 28 to Oct. 6. A later series of measurements in the same grove showed increased lemon growth of only about one-half packing size larger on the overhead irrigated trees than on the furrow irrigated trees. Similar measurements carried on in another grove irrigated under both systems showed but little difference. Further comparisons will be made.

On the whole, the amount of water applied in the overhead system in the grove with very large trees was about one-half of the amount applied in the furrow system, but this difference is due to the readiness with which the soil takes water; it is practically impossible to get the lower end of the runs wet enough without applying more water than the grove as a whole needs. Under our climatic conditions, at least, it seems that the overhead system may not be very economical of water in the groves with (say) half grown trees, because the whole soil area necessarily gets irrigated whether it needs it or not. In such groves the furrow centers do not need to be irrigated every time the soil area nearer the trees needs water. Our chemical determinations show, of course, a more uniform vertical distribution of the soluble materials in the soil under

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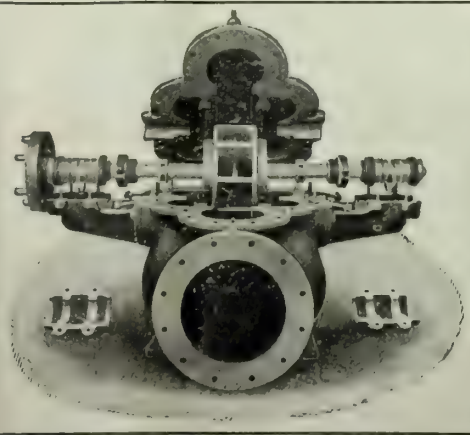

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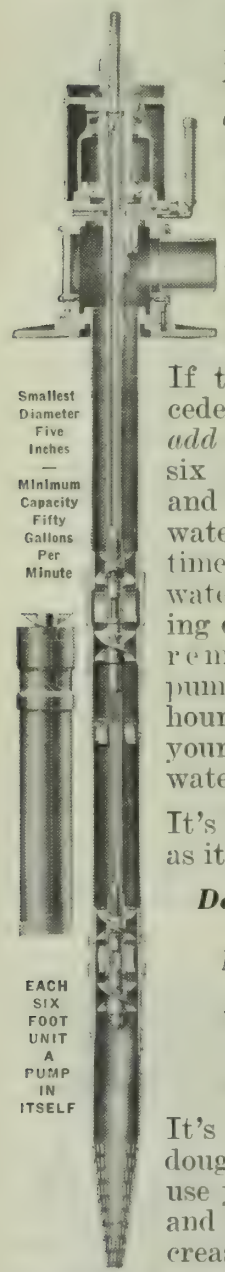

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the over-head system. On the whole, considering all the factors involved, we are not yet prepared to express a choice of systems under our soil and climatic conditions.

To sum up briefly our irrigation control method: We do not check up against each irrigation unit by moisture determinations in the laboratory for each irrigation. The time and expense would be quite an item as we have altogether about 102 citrus irrigation units, not counting walnut acreage, and about 500 acres of 2 year old citrus planting. We train ourselves to judge the moisture content in the grove and compare that with the moisture equivalent or the wilting coefficient, and then calculate the approximate amount of water necessary to apply to bring the dry soil area up to its moisture holding capacity. On some of the soil types a given amount of water can be quite closely approximated; on others, not.

Considerable interference among the various field operations occurs and it must be decided what operation should have the right of way. We do not put orchard tools into the groves, for instance, nor irrigate, just previous to picking if we can avoid doing so, as not only is the fruit knocked off but bruised fruit is undesirable in the packing house on account of decay, and a newly irrigated grove soil would be considerably packed by the pickers. Spraying for the control of brown rot often interferes with irrigation also. Because of so many factors involved in the smooth working of each department we have no established policy except to carry out each operation with as little interference as possible, and hence each superintendent and each foreman must respect the operations of the others.

San Diego Wants Water

The most recent step in the direction of San Diego, California, toward water development was made late last month when the city council passed a resolution decreeing the necessity of a $2,000,000 bond issue for water development in the Sutherland and San Vicente regions. According to city manager, F. A. Rhodes, Arthur P. Davis, a consulting engineer of Oakland, California, will make a selection of the type of dam to be used in the near future.

Chino to Expand District

The Chino Valley Irrigation District has been authorized to issue $85,000 worth of bonds for improvement work according to word from John W. Murphy, secretary of the district's board. Most of this is to be spent in the erection of a dam for further storage facilities that will assure the irrigation of an additional 2,538 acres of land.

An Industry On Desert Sands

(Continued from Page 24)

Another feature of the industry that has been given very close attention has been the breeding of a good laying stock; in fact, the laying stock is the vital and all important consideration here. The fundamental basis of a good laying hen are said to be: first, she has been bred for eggs; second, the proper feed is available; third, she has received good and proper care. Today the project's strain of high producing single-comb white Leghorns is known all over the country. The average hen in the United States produces about 82 eggs in one year. On commercial ranches a production of 110 eggs per year hardly pays the cost of production. Here a study of the individual trap nest records on the poultry farm shows a large number with a production of between 175 and 200. A smaller group shows 200 to 240 eggs per hen per year. A few hens have gone over 300 eggs per year.

All settlers on the project who desire to start a poultry plant of their own are given the opportunity to purchase baby chicks from this egg laying strain. After such a buyer has built his poultry plant according to the standard design, and has purchased Fontana white Leghorn baby chicks, he is given advice by the Fontana poultry expert solely for the purpose of keeping the industry up to the high standard which governs the operation of the project poultry plant itself.

Prosperity by Government Aid

(Continued from Page 14)

ability to make produce." The suggestion was that this unit be a quarter section.

The "Home Place" would pay rates on a schedule spread over fifty years. The assessed rate would not be reduced, but during the early developmental years the Government would assist the settler in meeting his assessment, in the following manner:

During the first year in which a Home Place was registered, the farmer is to pay no rates—the Government will advance the full assessment of $5.25 on his behalf. In the second and third years, the farmer will pay the water service charge of $1.25 per acre, while the Government advances $4.00. In the fourth year, the farmer is assumed to have obtained a start and his proportion will be $3.25 while the Government pays $2.00. Each fourth year thereafter the farmer's proportion advances $1.00 until eventually he will be meeting the full assessment. At any time the farmer may pay the full capital cost of $55.00 per acre and receive title to his water-right.

This schedule took care of the actual resident producer within the limits of the area granted for a Home Place, but any surplus land he might have owned had to bear the full assessed rate. The Government had said, "We will give relief, but not blanket relief." The man with more land than he could make produce will not be allowed to speculate with it, or keep it idle at Governmental expense. If he can not pay on his surplus land, then that surplus goes into the Rate Enforcement Return at the end of two years and becomes the property of the Irrigation District for resale to producing settlers.

Absentee owners can not qualify for Home Place privileges except by taking up residence. Naturally it is unprofitable to hold land out of production at $5.25 per acre annually so this land also finds its way into the Rate Enforcement Return.

Colonization Begins

So much for the machinery. What now was to be done to bring new settlers into the district? It was imperative, if the Government was not to lose considerable money, that vacant lands be settled speedily. Settlers are not readily picked up, and six or seven hundred were required urgently.

An important feature of the new Act was the appointment of a manager to administer the act. Having a status mentioned in the act this manager as "a corporation sole," was given wide discretionary powers. His word was to be final in administrative matters. He could buy and sell lands and he had money at his disposal for loaning to new settlers. The success or failure of the entire scheme depended on this manager.

The problem of the Lethbridge Northern district was one that few men would willingly tackle. The appointee would be required to put into effect a piece of legislation that had no precedent. Moreover he had to find seven hundred new settlers and at the same time adjust the affairs of old settlers. James Pike was appointed manager in May, 1925. He had been the manager of a bank and later was put in control of large land interests where colonization was an important feature.

When he entered into control, there was no land available for settlement. Vacant lands were plentiful but none could be touched except with the consent of the individual owners. No settlement policy could function under such conditions. Litigation had for a time upset the confirmation of the rate enforcement return. He proceeded,

(*Continued on Page 40*)

You *Name the* Load
We *Make the* Pipe!

SINCE concrete pipe (as made by Bent) came into its own, engineers question no longer its striking advantages for a great variety of uses. *But*—a concrete pipe installation is either a mediocre or an eminently superior job of work, depending upon who fulfilled the contract.

Many trade names have become hall-marks of tradition, that serve as an unerring guide to discriminating buyers. Today the name "BENT" on a joint of Concrete Pipe marks it as a strictly finely made product. The same care and skill is exercised in its manufacture, and in the laying of the line, as though every future contract depended on *that* job meeting the fullest requirements of specifications—*and more.*

Let us give you a "concrete" demonstration of what we mean by "Bent" Service.

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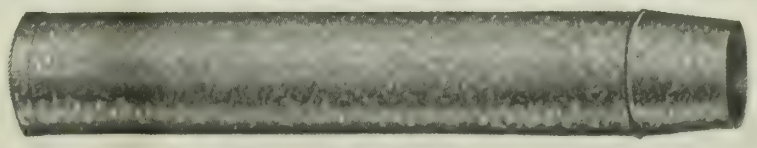

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Prompt Delivery—Write for Catalog and Prices
MANUFACTURED BY
WOOLWINE METAL PRODUCTS CO.
8th St. and Santa Fe Ave., Los Angeles

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TRADE NOTES *of the* MONTH

Officials Distribute Cataloge

The latest valve and fittings catalog combining two older booklets was released from the press last month by Commercial Iron Works. It is said to be a very complete list of price illustrations and other data interesting to persons connected with irrigation.

Claude Welcome of the Sales Department made a trip up through the San Joaquin and Sacramento valleys and back via San Francisco and the coast routes. He called on all the company's dealers introducing the new catalog and new fittings.

A representative stock of the well-known Dayton Coupling is being carried at both the Los Angeles and Fresno offices now, in addition to "Commercial" fittings.

J. A. Beck, Special Sales Representative for "Commercial" Natural Gas and Distillate Engines for almost 20 years, spent an extended vacation visiting his old home in North Dakota. He attended the 50th anniversary of the Custer Massacre of 1876. Mr. Beck was a sergeant in the famous 7th U. S. Cavalry in the early 80's when many officers and men who were with Reno's column on that day were still with the regiment.

Turbine Pumps Installed

What is said to be one of the very deepest of turbine centrifugal pumps is being installed for the Ontario Water Company by the Peerless Pump Company of Los Angeles. This pump has the bottom of the 18-inch pump bowls placed at a depth of 500 feet with suction pipe below. It has a capacity of 125 Miner's inches and will be driven by a 200 H. P. G. E. Motor. Royal V. Ward is the consulting engineer.

A deep turbine pump to deliver the water direct from the well to the top of the hills in one operation is being made in the El Molino district. The pump is being furnished and installed by this company also. It is a 13 Stage 18 inch pump driven by a 200 H. P. Western Engine. 100 Miner's inches will be pumped through two miles of pipe against a total pumping head of about 540 feet.

The Pacific Development Company of Los Angeles, has placed a blanket order for seventeen additional turbine pumps for their orchard and vineyard tract in Romola Valley in Riverside County. These pumps are to be built to fit the requirements of each particular well as it is drilled and tested.

Borrow Pits Drained

In building dikes and levees it is usually necessary to borrow the material for these banks from adjacent territory,

A reproduction of one of the "Calco" Automatic drainage gates used by the Roosevelt Water Conservation Company.

and this results in depressions which are said to be undesirable both from a health and financial standpoint. They form breeding places for mosquitos, and they represent that much tillable land which will not be put to proper use. In levee operations of the Roosevelt Company it was at first decided to allow the borrow pits to remain, as it was thought that the accumulation of water in them would be of little consequence. However, the next few rains showed that something would have to be done immediately as the levees were washed out.

The engineers ordered the ditch banks rebuilt and for the drainage of the pits installed Calco automatic drainage gates attached to corrugated pipe which are effectually keeping the pits free from water and preventing back-flow when the canals are running full.

Pump Booklet Ready

A booklet consisting of five sections on their pumps has been released by the Layne and Bowler Corporation, makers of Layne and Bowler Pumps. The book is said to be artistic and attractive from a make-up point of view as well as instructive and informative in its content. It consists largely of photographs and diagrams.

The first section, "A journey through pumpland," is devoted to the various types and services that this company offers. M. E. Layne, president, gives a personal account of the experience that the company has had in the pump field. The second section, "Heavy duty pump heads," is given over strictly to pumps involving this type of head. Pictures, diagrams, and explanations go to build a description of these pumps and their uses.

The third section, "Top head and type K pump heads," tells of the feature of the more simplified design of pump heads. These pumps provide for direct connection with vertical motors. The fourth section, "Type LFF pump heads," deals with full floating pump heads, a new development of this company. "Construction notes and useful data" is the heading on the fifth section.

Hollydale to Have Water

Proposing to operate a system for the delivery of water for domestic and industrial purposes to a subdivision on the Union Pacific Railway between the cities of Los Angeles and Long Beach, Hollydale Water Company recently applied to the Railroad Commission for authority to issue 1,000 shares of its common capital stock of the par value of $100 each. Of the stock issue 681 shares are to go to the Mercantile Investment Company in payment for the plant and equipment now in use. Most of the balance of the stock issue is to go to the same company and the money received for the stock will be used in development work.

Install Automatic Gate to Control Water Level in Canal

E. W. King, a civil engineer of Yerington, Nevada, has recently installed a Calco automatic radial gate, to act as an automatic spillway, near the intake of the Saroni Canal at Wellington, Nevada. It is shown in the accompanying cut.

This canal diverts water from the West Walker River and carries it into Smith Valley in Lyon County where it is used for irrigation of a portion of the

Automatic radial gate installation on Saroni

lands lying in the Walker River Irrigation District.

The flow in the West Walker River fluctuates considerably during each day, but the automatic gate is able to control the water level in the canal to a few hundredths of a foot. The capacity of the canal is 120 second feet. The installation of this gate has done away with the necessity of a watchman at the headgates.

Appoint Exhibits Committee for Water Works Meeting

The following committee has been appointed by the California Section of the American Water Works Association to arrange for manufacturers' exhibits at the Annual Convention in San Diego, October 28, 29 and 30.

R. W. Martindale, Pacific Coast Mgr., United States Cast Iron Pipe Co., Los Angeles, Calif. H. M. Dudley, Western Sales Mgr., McWane Cast Iron Pipe Co., Los Angeles, Calif. Frank M. Brooks, Mgr., Art Concrete Works, Pasadena, Calif. George H. Bailey, Pacific Coast Mgr., National Meter Co., San Francisco, Calif. J. R. Barker, Pacific Coast Mgr., Neptune Meter Co., San Francisco, Calif. (Chairman.)

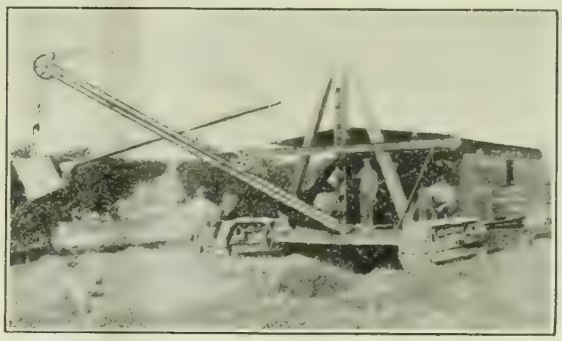
It is the intention of the committtee to carry on the work of previous committees at these yearly conventions. All of the exhibits must be in place at the American Legion Hall, San Diego, by the evening of October 27, Chairman Barker states. There will be ample space for those who have exhibited heretofore, and the committee would like to have additional exhibitors. There will be no charge for exhibit space.

On Friday night, October 29, a dinner and dance with entertainment will be given the Water Works people and their wives, the expense to be divided equally between the exhibitors.

For Cleanout -- Maintenance -- New Ditches

There's a Bay City for Every Job

BAY CITY Land Dredges span the ditch, can dig any desired slope, and dump waste on both banks. BAY CITIES leave clean, wide berms, and can work up or down streams. One trip over the ditch is enough. The Shovel Type Dipper handles hard material in which other types of buckets cannot make a good showing.



At left—One yard BAY CITY Dredge digging and cleaning ditches in Florida Citrus Groves.

BAY CITY Land Dipper Dredges are built to fit the job. Walking, Crawler, Track or Floating mounting. Easily dismantled, transported and assembled. Capacities ½ to 1½ cubic yards. Oil engine or electric operation.

FOR SMALLER DITCHES — OR PIPE LINE TRENCHES

The BAY CITY 16-B convertible Excavator will handle a wide range of work. Operates Dragline, Trench Shovel, Clamshell or Skimmer. All steel. Shipped assembled. Digs any width or depth up to 20 feet.

¾-yd. capacity

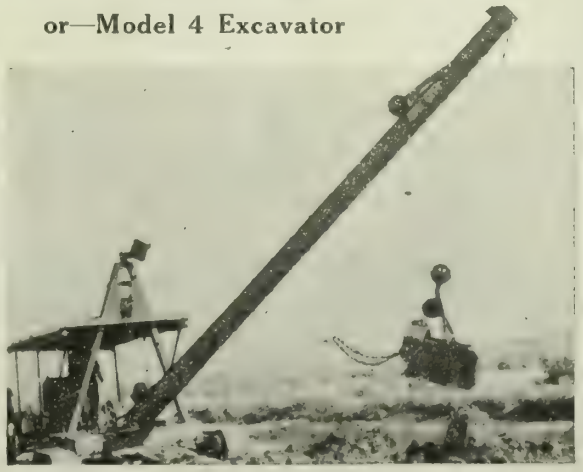
STEEL CONSTRUCTION

FULL CRAWLER MOUNTING

or—Model 4 Excavator

BAY CITY Model 4 is a small low-priced convertible, one-man operated Excavator. Fills the gap between hand labor and high priced equipment. Capacity 20 to 40 cubic yards per hour. Gasoline or electric power. A Real Digger economically designed for the small job. Also operates shovel, and clamshell.

WRITE FOR NEW CATALOG



One of the Model 4's Owned by Colorado Irrigation Companies. Cleaning Out Canal.

Our many years experience in manufacturing and operating Dredging machinery is at your service. Write us about your problem.

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RECLAMATION

Let the Engineer and Farmer Each Do His Share on New Irrigation Projects

By DR. ELWOOD MEAD*

CONGRESS in 1926 made appropriations for additional irrigation works which will provide water to irrigate 350,000 acres of land, at an average cost of about $120.00 an acre, for the works. The land to be reclaimed is unleveled, uncleared sagebrush. When canals have been completed, if no change is made in the land, in the interval, everything needed to convert deserts into farms will remain to be done. There can be no income to pay the expenses of operating and maintaining these canals, much less begin repayment of their cost, until settlers are on the land and the farms are made ready for crops. We have in the past built canals without regard to what was to follow their completion, in the careless and unthinking belief that agriculture would come automatically. We accepted as sound the assumption that money and direction were a necessity in building canals, but left the farms, like Topsy, to grow.

Misconceptions Prove Costly

Anyone who studies the report of the Fact Finding Commission, or the reports on the engineering, agricultural and economic feasibility of the proposed new projects, which came as its sequel, will realize how costly to the Government has been our misconception of this matter and how much injury it has wrought to the industrious, but over-confident settler and his family.

If we go farther afield and study the elaborate reports made in connection with the land settlement policies of European countries like Denmark and Germany, or the investigations which preceded the provision of $170,000,000 to finance farm development on irrigated areas in Australia, we begin to realize that here is a fruitful field of rural planning, which constitutes in many ways the greatest agrarian advance of the century and which has been almost entirely ignored and neglected in this country.

These researches have shown what was needed to create a farm, what incomes could be expected from them, what kind of crop marketing and business organizations ought to be created to enable rural communities to function as other business undertakings now function.

Australia Findings

At the end of a most exhaustive inquiry into the costs of irrigated land settlements, Australia decided that it would require an average investment of $6,000 to complete the development of a 20-acre fruit farm, and $10,000 to complete the development of an 80-acre dairy farm. It decided that settlers to be safe risks must provide a part of this development money, and this capital has been fixed at from $1,500 to $2,500; that a provision from some source for advancing from $3,000 to $3,500 to supplement the settlers capital and enable the farm to be made a going concern, must be made. The amount of settlers' capital, and the amount of Government advances vary in different countries, but in all where land settlement has become science, both are provided and all contain these provisions:

1. Amortized payments.
2. A low rate of interest, varying in different countries from 2½ to 5 per cent.
3. From 20 to 90 years in which to repay the advances.

It is because this country has done none of these things that we have reclamation projects with great latent advantages and resources which have been operated from ten to fifteen years at a heavy loss to the Government because from one-half to two-thirds of the land is still unirrigated and untilled. On every one of the projects where these conditions exist, the Government has already lost in operating expenses which can never be recovered, more than would have been needed to inaugurate and carry out a land settlement policy similar to that of Australia or Denmark.

If the experiment provided for in the bill introduced by Senator Kendrick, in the Senate, had been approved, it would have furnished an education in how rural communities can be created, that would have influenced rural development throughout this nation. If we had provided at the outset a land settlement plan like those of other irrigated countries, we would, on one-third of our reclamation projects have hundreds of farms and prosperous homes where we now have abandoned farms and untilled fields. We would doubtless have lost some money, but not one-tenth of what has been lost.

Leveling Not Part of Farming

The economic report, above mentioned, shows what it costs to change unleveled land into farms. The cost is an unquestioned fact, but we have sought to enable this expense to be overcome and to be met by deference of charges, but this expedient ignores the fact that the money required to make the farm a going concern must be spent before the settler can earn a living, let alone make payments for water.

We have also ignored another economic factor. Preparation of land for irrigation is not farming. On the contrary, it is an engineering operation. The implements used are strange and new to the cultivator from humid sections. Their cost is more than the beginning farmer can afford to pay. Leaving this preparatory work to the unaided and uncoordinated efforts of beginners, wastes the time and a large part of the settler's meagre capital. Not all men can level land. It requires a peculiar knack.

*This article is an excerpt from the paper presented by Dr. Mead, Commissioner of Reclamation, before the annual convention of American Society of Agricultural Engineers, Lake Tahoe, California, June 1926. This excerpt was arranged through the cooperation of W. W. McLaughlin, associate chief, Division of Agricultural Engineering.

The experiences which untrained beginners go through under our lack of system, are not only hard on the settler and his family, but try the morale of the Government officials who have to look on without being able to give the aid and advice which they realize are both needed.

Preparing land for irrigation is therefore a part of construction and ought to be so regarded. Every argument in favor of the Government building canals supports a definite program for preparing the land for irrigation with aid from some source where the settler is unable to do it alone. A carefully thought-out program for making farms ready for cultivation would attract more and better farmers to new projects. They could begin doing the things they understand. They would be earning a living almost at the outset. Now they have to risk their time and money in doing work of which they know nothing and which only experts can do well. It results in enormous waste of time, money, and effort.

Recognized by Private Projects

Private enterprise is learning this. At Montague, California, Dr. G. W. Dwinnell, a leader in reclamation planning, after he had completed the irrigation works, mortgaged the land for money with which to make the farms under them ready for settlers. He leveled the land, seeded part to alfalfa, and hired a few good carpenters to build houses and barns. He did this at far less outlay than it would have cost settlers. He bought carload lots of high grade Holstein cows which he sold to settlers at cost on time payments.

The plan sold the farms. Settlers could start with an income in sight which is a wonderful aid to courage and confidence. The scheme has been a financial success. Not a single settler has failed and Dr. Dwinnell has not had to worry over unsold land or delinquent payments.

At Los Molinos, California, unimproved farms were sold to settlers without any inquiry as to their capital or plan as to what they were to do. Long before development was completed, their money was gone, and they faced disaster. It happened that Frank Vanderlip was a stockholder in the project. He went down in his pocket for a quarter of a million dollars; loaned it to these settlers, and by so doing saved their homes. Without help at this time, Los Molinos would have been a social tragedy. Credit made it one the most prosperous colonies in northern California.

Los Molinos is a near neighbor to Durham, one of the two California State land settlements. At Durham the money

CLEARFLOW

INCLINED SEAT CHECK VALVES

BUTTERFLY VALVES

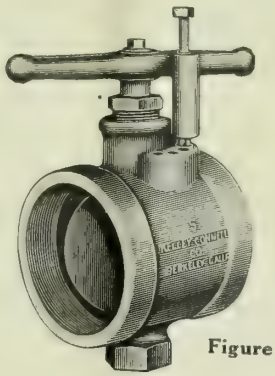

Figure 20

Butterfly Valves

Flanged and Screwed

Regular and Side-Outlet.

Bronze gates and moving parts.

Close-fitting and well-finished.

Elbow Check Valves

Silent
Reliable
Less head loss
More compact
Easier access to pump

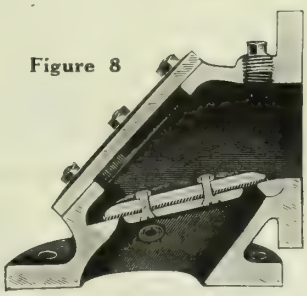

Figure 8

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AT LOW COST

THE NEW RUTH WITH ITS CONTINUOUS FLOW OF DIRT will dig or clean canals and trenches at a minimum cost per cubic yard or lineal foot heretofore considered impossible. The Ruth cuts continuous, even banks and smooth bottoms. Working successfully in marshy or dry ground, or canals full of water. The Ruth positively cleans the canal of all muck, sand, small willows, tules and water grasses.

Send for Bulletin No. 8—it illustrates the New Ruth Dredger; type and size of canals it will dig or clean; gives specifications, operating costs and maximum capacities.

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Have You Seen the New Straight Drive PACIFIC PUMP?

Its exclusive feature—7½ to 50 h. p. motors interchangeable on the same head, an advantage of great economy. Each a compact unit; perfectly aligned; no flexible coupling. All parts easily accessible. PACIFIC PUMPS are remarkable for Silent, Smooth Service, Endurance and Economy.

Call, write or phone MIdland 3101

Pacific Pump Works

350 Bicket St.
Huntington Park, Calif.

CATALOG and ADVISORY SERVICE ON REQUEST

used in preparing the land for irrigation and seeding it to alfalfa was obtained from the Federal Land Bank. Settlers have 34½ years in which to repay this cost. Payments are amortized. A yearly payment of 6½ per cent keeps up interest and pays off the debt. If these settlers had had to pay 8 per cent interest on money borrowed to prepare their land for alfalfa, or pay off the loan in ten years, nine out of ten would have failed. If they had been left to level and seed the land without aid or direction, Durham would have been a fiasco. As it is, it has an international reputation as an example of success in rural planning, and in showing how poor men can be helped to become farm owners.

WISCONSIN CO-OPERATES

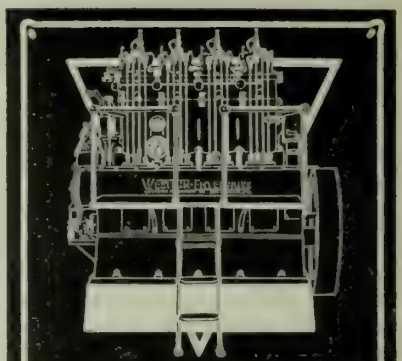
Wisconsin has co-operated with private colonies in securing funds to build houses, clear land for settlers for the cutover areas of that State. Mr. Hugh MacRae of Wilmington, North Carolina, has blazed a trail in scientific land settlement that is well worthy of study by all students of the problem of how to attract and hold people on the land. The basis of his system is to have development work completed before the settler comes on the land. The farm is a going concern, is sold on long time payments, and the settler is given expert advice regarding his crop program.

Prosperity By Government Aid

(Continued from Page 35)

however, to register resident farmers for their Home Place units, a task that was fraught with many difficulties. From each applicant for Home Place a statement of the man's affairs had to be taken and an attempt made to adjust his debts to a point where the farmer would have a chance to make good.

In the meantime, the larger problem of colonization was never lost sight of. Where, at first, it was a moot question whether settlers could be obtained, the problem now began to solve itself. Attracted by the new water schedule, settlers were actually clamoring for locations. The litigation was still in progress in January, 1926, but it was settled in favor of the District in April. There were, however, two large blocks of land owned by a railway company and a trust company. These concerns realized that eventually their lands would be lost. A deal was made and the manager secured these tracts at a nominal sum. The wide publicity given to the taking over of these lands had a psychological effect on prospective settlers. The terms were easy—no down payment, nothing to pay



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Power that is dependable under all conditions, at all times; immediately available in any crisis; always ready for instant service; no "minimum" costs when idle, but decidedly minimum when operating.

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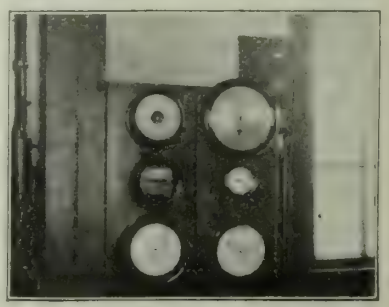

Sheffield Power Co. Measures Water Flow with Republics

The above illustration shows a panel board with Republic Indicating, Integrating and Recording instruments. These are used by the Sheffield Power Company, Sheffield, Alabama. They average 1,000,000 gallons per day—pumped to the surrounding cities. Every gallon is checked by Republic Water Meters.

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Because of the demand among irrigationists for "Modern Irrigation" since it made its bow to public a year ago, our supply of certain issues has been exhausted.

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For Detailed Listings, Branch Offices, Etc., See the Buyers' Guide to Leading Supply Sources—Pages 55-56

the first year, and the prices (less water right) ranged from $10.00 to $15.00 per acre on crop payments. There was literally a rush for land.

Where Did They Come From

Where did these new settlers come from? There is a piece of country known as Southeastern Alberta which in late years has suffered acutely from long continued dry periods. Fifteen or twenty years ago this country was settled by a very fine class of Canadian and American farmers. They practiced what is known as "Bonanza Farming." Wheat ranches of a thousand acres were common and the work was done with tractors. The first years were lucky years. The soil was virgin and fertile. Rains came and fortunes were made from wheat. Then wheat began to take its toll. The fibre disappeared from the soil, and summerfallow was resorted to. The people refused to give up, but rains did not come. Hope gradually gave way to despair and, finally, when the Lethbridge Northern district opened its doors, these men came forward with nothing but their horses and equipment.

What better type of farmer could be desired? The Alberta Government killed two birds with one stone when it welcomed these men to share in the fruits of irrigation. And how they do appreciate the water! The old hope, the old faith is still there. It was never killed.

Entire Project Moves

Two hundred and fifty new families, equipped and ready to go, have been placed in the Lethbridge Northern district since January 1st., 1926. The roads have been crowded all spring with vehicles of every description bringing in settlers. Whole buildings have been moved, some as far as fifty miles, while others have been broken up and transported as lumber. The Government issued free freight warrants, and new hamlets are springing up throughout the district. The Canadian Pacific Railway which already serves the district with two lines, has recently completed a third. In all, there are nearly 600 families now resident in the district where there were barely 350 in 1924.

In 1924, the Lethbridge Northern crop census showed a production of $500,000.00. In 1925, the production increased to $1,300,000.00. The new acreage under crop this year promises a production of $2,000,000.00, and there is still room for three or four hundred new families.

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Both USED and NEW--At a SAVING to YOU!

WHENEVER and wherever you need pipe of any size or dimension, Pacific can serve you and save you money, too. For general farm and irrigation purposes, Pacific Reconditioned Casing is a real bargain. Absolutely guaranteed. Every length straight and clean with new threads and couplings, each protected from damage in shipping by special steel protectors.

Every length rattle-tested and steam pressure-tested as proof against weakness; then dipped in a special non-tasting hot asphaltum which resists alkali and corrosion. This adds years to its life. Nowhere else in the West, except in the Pacific plant, can used pipe be so thoroughly reconditioned and then sold at such low prices.

Ask either office for prices and free descriptive booklet

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WHO'S *WHO* AND WHO'S *WHERE*

IN THE WORLD OF HYDRAULICS

Personal Notes and Impersonal Observations About Men You Know

D. W. Murphy, prominent consulting engineer of Los Angeles, spent his vacation in San Francisco, the latter part of July and the early part of August.

A. C. Houghton, of Attalia, Washington, for ten years manager of the Attalia Irrigation District, has recently been appointed the new manager of the West Extension Irrigation district, according to word received from Hermiston, Oregon.

According to the latest advices from Major Olberg, in charge of the construction of the Coolidge dam project in Arizona, bids for the construction works will be called for within the next ninety days. Money has been appropriated for the first work to begin on the dam which will be the first multiple dome type to be built.

Dr. Elwood Mead, Commissioner of Reclamation, has just returned to Washington from an inspection tour of the western states and the federal projects there. Mr. Mead has submitted his report to the Secretary of the Interior, and has stated that the morale of the farmers on the projects is much higher this year than it has been in the past.

J. B. Brown, extension specialist in irrigation at the University of California, has been conducting tours for overhead enthusiasts during the last month. A study of root distribution, water penetration, methods of application, and the part that cultivation plays in moisture penetration are the subjects that were discussed.

The names of new directors for the Moreno Mutual Irrigation Company, California, have been announced. The directors are Louis H. Didier, president; F. L. Towner, vice president; C. O. Lantz, treasurer; Albert A. James, secretary-manager. George E. Holyoke is chief engineer in charge of construction, and F. E. Trask, of Los Angeles, is the new consulting engineer.

Ralph Criswell, for nine years chairman of the Los Angeles (Calif.) Power and Light Commission, recently addressed a large gathering of Lomita (Calif.) citizens on the merits of a water system for Lomita, and its relation with the city of Los Angeles. He outlined the costs of such a system and compared the present value to the future value of the lands affected.

C. H. Pease, editor and business manager of the "Delta Irrigation News" and a prominent authority on irrigation matters, has just returned to Mc Allen, Texas from a tour of the western states and an inspection of their irrigation projects. Southern Oregon, the Yakima Valley of Washington, Shoshone Project, and North Platte, Wyoming, were among the projects that Mr. Pease visited.

"If the products of all the oil wells of California were permitted to flow undisturbed into the sea the loss would be less than the loss of the precious fluid of the mighty Colorado River that is poured into the Gulf of California," said Friend Richardson, governor of California, in speaking of the Colorado river recently and the importance of harnessing it with the view of preserving its waters and energy for use in the southwest.

Professor Charles F. Shaw, soil technologist for the College of Agriculture, University of California, has recently accepted an invitation from J. Sanchez Mejorada of the Mexican reclamation committee to make a complete survey of the agricultural possibilities of the Santiago district at Aüguas Calientes, Mexico. It is said that this is in preparation to the inauguration of a large irrigation project there.

R. F. Del Valle, president of the Board of Water and Power Commissioners of the city of Los Angeles, has been reelected for the ensuing term. James B. Baker has been elected vice president of the board for the same period. John R. Richards has been appointed to fill the vacancy left on the board by the resignation of C. A. Dykstra, who was recently transferred to the position of efficiency and personnel director of the department.

John H. Mann, of the Commission of Public Utilities of Portland, Oregon, reports that R. V. Meikle, a prominent consulting engineer in the western irrigation field, spent a few days in Portland recently advising the officials of that city as to the feasibility of constructing an immense water reservoir. The reservoir is to be planned for Bear Creek, and it is said that more than 11,000,000,000 gallons of water will be impounded there. Mr. Meikle has been associated with the Exchequer, Don Pedro, (both of California) and the Bear Creek projects.

Albert Givan, chief engineer of the Sacramento (California) municipal utility district, and assistant engineer, E. D. Hayward, headed a party of officials from Sacramento recently that made a trip to Ice House and Union Canyons with the view of considering harnessing streams therefrom for the future water and power supply of the city. It is said that the district is capable of storing 210,000 acre feet of water and developing 91,500 continuous horsepower. It is also said that more than 200,000,000 gallons of water could be delivered to the city for its domestic supply.

Edward I. Kotok, for 15 years an officer of the California district of the United States Forest Service, has been appointed the director of the new forest experiment station to be established in San Francisco, according to an announcement by Col. W. B. Greeley, chief forestor. Mr. Kotok started his service in the Shasta National Forest in 1911 and in 1919 was made fire inspector for all the national forests in California. The other appointments to the new station include Duncan Dunning, silviculturist of the California district; A. E. Wieslander, technical assistant from the Lassen National Forest; and H. A. Higgins, junior forester.

Forest Fires Take Annual Toll of Millions in Western States

A forest fire that ranged along a six mile front in Tuolumne county, California, has swept away thousands of dollars worth of Hetch Hetchy property, according to press reports early in August. The entire system was threatened for a while, but the fire was finally put under control by 250 fighters from the Pacific Gas and Electric and the Hetch Hetchy companies. The Early intake unit was put out of commission by virtue of destroyed lines, and a similar fate was feared for a while for the Modesto Creek unit.

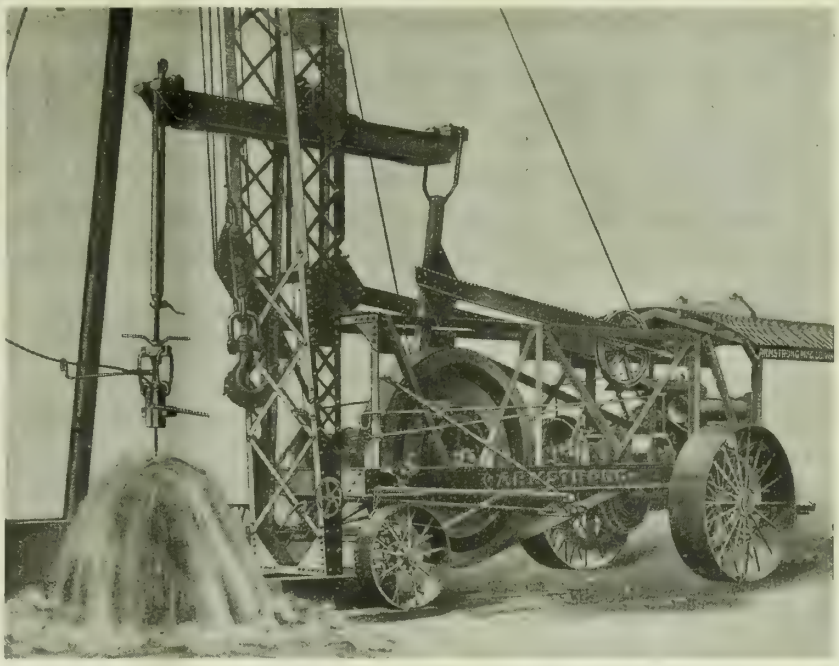
Other fires this season have destroyed much property and laid barren vast water sheds, according to official figures given out from federal and state authorities in Denver, Colorado. It is reported that approximately 600,000 acres have been burned over and that property losses have amounted to several million dollars.

It is stated that California is the heaviest sufferer, with 219,000 acres of national forests and adjoining lands devastated. Between 6,000 and 8,000 men are still employed by the federal and state governments in California to stem the fires that have proved the most serious in a decade. Over 4,000 men have been employed by the governments in Washington, Oregon, Idaho, British Columbia, and Montana. The following is the officially estimated data on the destruction rendered by specific fires:

Kaniksu National Forest, 2500 acres burned over; Pend Oreille, 14,000; Couer d'Alene; 15,000 acres in Stevens county, Washington; 24,000 acres in the Chelan and Colvin National forests of Washington; 50,000 acres in the Cascade Range in Southern Oregon; 11,000 acres between the Columbia River and Eugene, Or., between 20,000 and 30,000 acres of slashings and logged-off land; Crater National Forest in California, 3600 acres.

Earl C. Pound, president of the Imperial Irrigation District, has returned to the Imperial Valley after having spent several days in Los Angeles, in conference with the Boulder Dam Committee of the Los Angeles Chamber of Commerce. The committee will meet again in the near future, it is reported, to act on the feasibility of petitioning congress to appropriate a million dollars for levee construction work along the river in Mexico.

The offices of J. R. Mason and Company, San Francisco, California, have announced the purchase of $500,000 worth of bonds issued by the Mohawk Irrigation district. The issue was unanimously approved by the voting landowners last February. The sale was made by the district's directorate.



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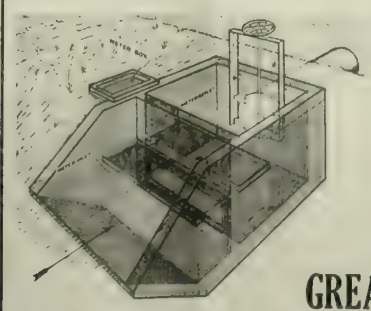

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Water Rights in Utah

A Party Having Been Adjuged the Owner of Water Cannot be Deprived Thereof Without A Clear Showing of Abandonment

In the case of Torsak v. Rukavina: (Utah: May 11, 1926) 246 Pac. 367, the defendant set up a former adjudication of water rights as a defense to plaintiffs claim of unlawful interference with his right to the use of certain water.

In supporting the judgment of the trial court in favor of defendant the Supreme Court of Utah says:

"Another answer is that, although the testimony of the plaintiffs witnesses that within the last three or four years immediately preceding the trial of this action the defendant permitted a small quantity of water to flow down a certain creek, or water course, was uncontradicted, yet, in view of the finding upon the plea of res adjudicata, that had no effect, and could have none, upon what its findings and judgment should be. The mere fact that the defendant permitted some water belonging to him by virtue of the former decree to flow down the stream in question would give the plaintiff no right to claim that the water, without alleging and proving that defendant had legally abandoned the right to use the same by not applying it to a beneficial use for a period of seven years or more, or without alleging and proving that he had actually and intentionally abandoned his right to the use of said water."

Damage Suit Plea for Defense in

Act of God As a Defense Should Be Pleaded

In the case of Fort v. Brighton Ditch Co., 246 Pac. 786 (Colo.) April 19, 1926, the Supreme Court intimated that the defense of Act of God in a suit for damages arising through the breaking of a dam caused by heavy rains should be pleaded to be available. In the instant case proof was insufficient to support the plea so the question was not directly decided.

What Constitutes Title by Prescription?

In order to obtain title by prescription to water the use must be open, notorious, continuous and under claim and color of right.

In the case of "in re Water Rights in Ahtanum Creek and State v. Achepohl et al," 245 Pac. Rep. 758, the Supreme Court of Washington held: "Adverse use of water for statutory period must be open, notorious, continuous, and under claim and color of right, and any act done by other parties claiming water that operates as an interruption, however slight, prevents acquistion by adverse right."

The court further held "Claimants' right to use water of the creek is not established by estoppel, where the use thereof was in violation of a court decree, and other users along the creek always objected to such diversion."

State Labor Law Not Applicable to Irrigation

Attorney General U. S. Webb, Renders Opinion to Labor Commission on the Question of the Application of the Eight Hour Law to Irrigation Districts.

In an opinion under date of July 22, 1926, requested by Walter G. Mathewson, Labor Commissioner, U. S. Webb, Attorney General of hte state of California, holds that Article 20, Sec. 17 of the Constitution, wherein it is provided that "The time of service of all laborers . . . employed upon any public works of the State of California . . district . . . or any other political subdivision thereof . . . shall be limited . . to eight hours in any one calendar day . . ." does no apply to Irrigation Districts. That the use of the word "district" in this provision is to be considered as referring to such "districts" as may be considered political subdivisions of the "State". An instance of such district would be a school district which functions politically. Also in support of this position he quotes Section 653c of the Penal Code as follows:

> "Section 653c of the Penal Code was adopted by the Legislature to make effective the constitutional provision. It is to be noted that the legislature in so enacting the penal provision contained in this section eliminates the word "district" as found in the constitution and provides that the time of service of any laborer, workman or mechanic, employed upon any of the public works of the State of California, or of any political subdivision thereof, or upon work done for said state, or any political subdivision thereof" is limited to eight hours during any one calendar day.
>
> The Legislature therefore appears to have considered that the district referred to in the Constitution is such a district as may be considered a political subdivision of the State.

The Attorney General holds that an irrigation district is not a "political subdivision" so as to come within the eight hour law.

In referring to an earlier opinion rendered by his office to the labor commissioner (April 16, 1924) he states that in his opinion Section 10 of the Wage Law, requiring semi-monthly payments, did not apply to Irrigation Districts as the exception including "employees directly employed by any county, city and county, incorporated city or town or other municipal corporation," would include irrigation districts under the term "other municipal corporations". (Citing In re: Madero Irrigation District, 92 Cal. 296), but that situation is not present in the question presented.

Annual Assessments for Bonds

Must An Irrigation District's Annual Assessment Be Sufficient Each Year to Provide For the Payment of All Bond Interest and Principal?

A decision which appears to be somewhat inconsistent with a recent line of authorities from other states is rendered by the Supreme Court of Colorado in the Case of Board of Commissioners v. Heath, 246 Pac. 795 (May 3, 1926).

An irrigation district required a certain sum to pay bond, principal and interest. An assessment was levied in a smaller amount and a Writ of Mandamus is sought in order to require the full levy. The directors of the district answered, setting up, in effect . . . that there were enough outstanding and uncollected taxes of that levy to pay . . . bonds and interest in full . . The Court states: "We must presume, though it is not alleged, that these taxes are collectable. The presumption is that men will perform their duty and pay their lawful taxes. If for any reason these taxes are not collectable, that should be shown by replication, or should otherwise be made to appear in the record . . . The case must be reversed, with directions to discharge the writ, or, if petitioner desires, to take such proceedings as will properly raise and determine the issue whether these taxes are collectable to a sufficient amount to pay the bonds outstanding."

Irrigation Districts Held to Be Corporations

An Irrigation District Acts As a Private Corporation As Respects Ordinary Business Transactions

In the case of State v. Dilworth (April 12, 1926) 246 Pac. 167, the Supreme Court of Montana makes a distinction as to the capacities of an irrigation district, holding as follows:

"An irrigation district is a public corporation (Crow Creek Irr. Dist. v. Crittenden, 227 Pac. 63) and is governed by a board of directors which constitutes its corporation authority, and is charged with the duty of managing and conducting its business affairs. So far as its ordinary business transactions are concerned, they stand upon the same footing as a private individual or the directors of a business corporation similarly situated."

In defining the status of district warrants the court further states: "This order, sometimes designated a warrant, is merely a direction to the custodian to pay the specified sum, and in effect amounts to nothing more than would a bank check upon the district's depository, if its funds were handled in that manner; it is merely a device for properly drawing money from the custodian or depository. There is no statute conferring any special characteristics upon these orders or warrants."

Water Right Held Property Right

Water Rights Under Colorado Law

In the case of Ft. Lyon Canal Co. vs. Rockyford, etc. Co., 246 Pac. 781 (Colo. May 24, 1926) the Supreme Court of Colorado states that it is the settled doctrine of that state that a right to divert water from its natural streams and to use the same for growing crops is a property right; that it is not essential to its continued existance that the water thus diverted be forever used on the particular tract of land to which it was first applied, but its owner may sell it, separate and apart from such land, for use on other lands of the grantee or he may himself change the place of use or point of diversion, so long as the vested rights of other appropriators are not thereby injuriously affected.

No Lien Established by Rice Ditching

The construction of ditches for raising of rice does not give the contractor a right of lien on the land.

In the case of Ogden v. Byington, 71 Cal. Dec. 217 (Feb. 16, 1926) the Supreme Court of California makes a distinction between ditch construction necessary for rice raising as opposed to ditching, leveling, checking and draining necessary for alfalfa growing (Mendoza v. Central Forest Co. 37 Cal. App. 289). The question arose on a suit brought by plaintiff to foreclose a mechanic's lien on the land for work done in the construction of ditches.

In the Mendoza case the trial court found that the work done for alfalfa was of a permanent character and constituted a "structure" within he meaning of Sec. 1183 C. C. P. constituting a permanent and valuable improvement to the land and necessary to its highest and most profitable uses.

In the Ogden case the trial court found that the materials furnished and the work done were solely and only done in the preparation of the land for the cultivation and raising of a crop of rice thereon and that no value was added to the land by reason of the work.

The Supreme Court then states "that the character of the work done and materials and supplies furnished and for which a lien is sought to be established and foreclosed in the instant case (Ogden) was not such in point of structural character or permanency as would bring it either within the provisions of Sec. 1183 or 1191 of the Code of Civil Procedure so as to subject the lands of respondent to any lien predicated upon the performance of the plaintiff's contract with the respondent's tenant and for the collection of any balance claimed to be due from such tenant by virtue thereof."

Text On Hydraulics Out

Supplying the profession with a text book on the technical angle of hydraulics, McGraw-Hill Book Company has recently published Joseph N. Le Conte's "Hydraulics." This book deals with the theory of hydraulics and the principles of hydraulic machinery. The student in this field is here shown how engineering problems can be reasoned out and solved by appeal to first principles. The text, while technical in its trend, is fundamental and basic to the engineer or layman seeking a book dealing with a technical subject in a practical way.

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OVERHEAD IRRIGATION

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IS NEW PIPE BETTER FOR OVERHEAD THAN OLD?

THERE are several different opinions with regard to many of the practices and materials used in installing overhead irrigation systems but the three major subjects now under discussion are: new or old pipe; wide or short coverage sprinklers; comparative even water distribution and functioning efficiency of various sprinklers.

There are, of course, two sides to these questions to cause them to assume their present prominence. It is only with a view of providing some interesting information to the prospective purchasers of overhead irrigation systems on the matter of old or new pipe that this is written at the present time. With so much improvement work going on in sprinklers the time is hardly opportune for drawing conclusions as to the coverage, distribution and functioning efficiency of various sprinklers.

Duties Summarized

To summarize the duty of pipe, the prospective purchaser should take the following into consideration in considering the relative merits of used and new pipe: The pipe should conduct water under 40 to 60 pounds pressure per square inch with not more than 15 to 20 pounds friction loss from supply to sprinkler risers; there should be little or no loss through leaks in the pipe or through weldings or fittings; the pipe should be capable to perform its duty not for stretches of from 6 to 12 hours at a time, but periodically and continuously; the pipe should be of such metal so manufactured, reconditioned, and protected and so installed either by welding or screw jointing as to reasonably assure from 10 to 15 years or more service from the water distributing system.

Old and new pipe generally available for service in the larger sizes suitable for the mains for the system are in following classes: old and new black iron standard, new riveted black iron and, recently, new high-pressure concrete pipe. In the intermediate sizes—that is, from 2 to 4 inches O. D., used or reconditioned boiler tubing is obtainable in considerable quantities.

It is the last class of pipe about which the arguments for and against old and new pipe are centered. The bulk of pipe used in most systems is of these sizes, and to date three-fourths of the systems in the southwest have utilized this type of material practically throughout. How well this has been selected, reconditioned, protected and installed, only time will tell, although in some systems rust is already showing through pits, welds and thread connections.

FROM the accompanying remarks the conclusions may be drawn that good system engineering should accompany very careful selection and installation of reconditioned pipe. The engineering of an all new pipe system must be even more carefully performed to maintain proper balance between the economy of smaller sizes and the dangers of its being too small for the purpose and for long continued trouble-free service. The author discusses the first important problem that is encountered in the planning of the installation of an overhead system. Next month he will take up another important question on overhead irrigation in MODERN IRRIGATION.

The real case of the new pipe proponents against the use of boiler tubing does not question so much the heredity of the used tube as it does the careless selecting, reconditioning and protecting of the tubes. New boiler tubes are of high-grade charcoal iron either seamlessly drawn or made with wide lap welds to unquestionably stand high steam pressure and heat with wide margins of safety. For this reason they are usually relieved of further boiler duty long before their race is run. The texture of their metal is such as to be affected only slowly and superficially by oxidization, "ferric oxide" of tubes is in the form of dust rather than in flakes as is the case with lower grade pipe.

However, the action of intense heat and water with its various chemical contents, pits and limes the tubes inside and out. It is in this condition that the various western reconditioning yards receive their stock of tubes and their responsibility begins. It may be said here that not over seventy per cent of the general run of tubes should pass the selection test. The raveled ends resulting from their removal from the boilers are then cut off; the tubes are then placed in a big cylindrical tumbling rattler where water plays on them. The lime and scale is removed more or less depending on length and thoroughness of the treatment. The tubes are then generally tested with water or steam pressure from 100 to 200 lbs. and leaks are either patched by spot welding, or the tube is discarded to the fence post pile.

Protective Treatment

The protective treatment usually consists of submerging a bundle of tubes in a hot dip of asphalt or a petrolastic cement, once or twice and in periods of varying duration to permit the tubes to expand and receive the molten preservative in the pores of the metal.

The reconditioning process of used standard pipe is similar to the foregoing and the dipping of such pipe and new black standard pipe is performed in much the same way, though on special orders the ends of the pipe are sometimes capped, excluding the dipped solution from the inside of the lengths. The application of the preservative should be made within a few days of the pipe's being placed under ground and the pipe should be carefully handled in the meantime to avoid scratching off any of the coating.

Other preservative solutions and coatings are being used to further protect pipe laid in other soils. For instance, red lead has been found superior for pipe to be laid in adobe or clay soil. The tenacious cling of adobe to an asphalt coating, while adobe soil is contracting and cracking through evaporation, is reported to tend to strip a pipe of its protection in a season or two.

(Continued on Page 48)

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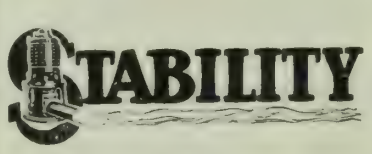

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OVERHEARD AMONG THE *OVERHEADS*

J. Glover of the Browning Construction company has just returned to Los Angeles from the north where he reports a growing interest in overhead irrigation systems.

The Buckner Sprinkler Golf King No. 3, also their quick coupling, has been specified for the El Sereno Country Club irrigating system on Alhambra Road, Los Angeles, Calif.

Thirty trees, on what is said to be one of the best known overhead irrigated groves, that of F. H. McPherson at San Gabriel, (Calif.) have been equipped with the Brooks spray head, one to each tree. With this system it is said he can get an irrigation very quickly.

Bringing the total of installations to fifty-six, Albert E. Harris has completed systems during the past few weeks for Dr. Gaston of La Verne, 10 acres; L. M. Hill, 7 acres at Glendora; Mrs. F. H. Cannard, 5 acres lemons at Glendora and a small system for J. Shoemaker, Glendora realtor.

The Shoemaker grove at Placentia, (Cal.) and the Visel grove in Santa Ana Canyon southeast of there are said to be pioneer groves equipped with the Vacher Sprinkler head. These systems were both installed by the growers themselves. No expense was said to have been spared to install the work as they desired.

Skeleton pipe line systems to utilize portable sprinkler stands are features of the recent installations of Samuel H. Gerson. The same system was installed recently on eight acres in the San Dimas canyon grove of the Gillete Bros. and a similar installation has just been completed on the Richard's Crown ranch at Corona (Calif.).

A Hadden automatic control system measures the amount of water applied to the grove that is under overhead irrigation on the Citrus Experiment Station of the university near Riverside, Calif. By the control feature the water is turned off and on the various units on a set and predetermined program, permitting penetration into the comparatively heavy soils, between applications of water.

An overhead system on the contour planted hillside grove of limes, lemons and avacados of John Morton, deputy county assessor in North Whittier Heights (Cal.) has just been installed under the engineering plans of Wm. J. B. Stewart. The system operates in three units, and the direct pump equipment, control valves, are all housed in a structure of Spanish design in harmony with the new $40,000 home just completed on the hill-top site.

The largest overhead system in the southwest, that of 63 acres on the foothill lemon property of A. M. Stevens in the North La Verne, (Calif.) district has been enlarged during the past few weeks by the original contractor, Clarence H. Thomas with addition Orr Compound Sprinklers. The 18-acre unit that has been installed is on unplanted land of irregular topography and soil. It was considered waste land, if irrigated by the furrow method, without an excessive expenditure for grading or a concrete pipe system. The area is now being planted with lemon trees with a cover crop.

The irrigator on Mr. Steven's place formerly needed help to get the 63 acres irrigated in 25 to 26 days but he now irrigates the property in 5 or 6 nights' operation.

The Right Pipe for Overhead

(Continued from Page 46)

"White pipe" or galvanized standard is obtainable in 2 inch and smaller sizes and is being increasingly used. Especially is this true above ground for rotary sprinkler risers and straight line nozzle system laterals.

A practical overhead irrigation system should generally avoid the use of much small size pipe; that is, ½ inch, ¾ inch and 1 inch because of the pressure head loss. Liming tendency and structural weakness of such sizes as compared with larger sizes are also a drawback. Where the capacity is small, vibrationless sprinklers or sprays must be used as along the edges of systems, the use of small sizes should be carefully figured.

As 1½ inch I. D. is the smallest reconditioned pipe regularly available, the probabilities of the use of too small pipe in the laterals of overhead systems rather eliminates itself, generally speaking.

WHAT IS *YOUR* PROBLEM

FREQUENT requests for authoritative, unbiased information on overhead irrigation systems, co-ordinating the hydraulic, mechanical and agricultural requirements thereof, has led MODERN IRRIGATION to secure for its readers the services of Lippincott and Stewart, consulting hydraulic and overhead irrigation engineers.

In this department, questions of general interest to overhead irrigators will be answered for our readers.

I have natural gas within a half-mile of my grove. Is it reliable. Would it pay me to bring it to my pump house site rather than use electricity? J. S. T. Foothills, Los Angeles County.

On rates prevailing in your district gas will furnish you satisfactory power with suitable engine equipment for 25 to 35 per cent of the cost of electricity although your power plant investment will be considerably greater, to which should be added the cost of the pipe line necessary. The quantity of power required would determine whether the investment would pay for itself or not.

Do I understand that an overhead system eliminates the necessity of all cultivation? S. T. H., Orange County.

That would be too strong, although there is a great diversity of opinion regarding the cultural care necessary in connection with an overhead system. Where summer and winter cover crops are carried it is practical to get by with discing these two crops under, but one subsoiler run between the rows each way during the early spring dormant period will aeriate and benefit the soil.

Do you think that three quarter inch riser pipes have anything to do with the dry spots between sprinkled areas my system has shown? J. A. R., Butte County.

If the type of sprinkler you mention is used with over thirty pounds pressure the small risers are very largely to account for the dry places. The recoil of the discharging water almost undoubtedly bends back the riser, elevating the angle of trajectory or discharge so high that the water loses distance by rising too high into the air.

Has anything practical been devised to keep overhead water from running down trunks of trees and soaking the root crown? I believe this is a very important matter. G. M. P. Foothill District, Los Angeles Co.

There is a protector, primarily designed to keep ants, spiders and other crawling insects from ascending tree trunks that also performs the above service, very effectively, it is reported.

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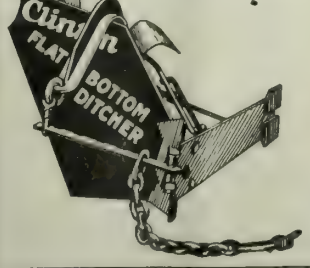

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4. Erosion is minimized in the flat bottom ditch.
5. It can be cleaned out with greater ease for it keeps its shape.

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SURVEY *of* HYDRAULIC DEVELOPMENT

As Shown by Official Records of the Month -- Local, State, and Governmental

Applications Filed

Among the applications for permits to appropriate water filed with the State Department of Public Works, Division of Water Rights, (California) during the month of July were the following:

Application No. 5128 (Amador & Calaveras Counties)—East Bay Municipal Utility District, 1924 Broadway, Oakland, Calif., for 375 cubic per second and 217,000 acre feet per annum from Mokelumne River tributary to San Joaquin River to be diverted in Sec. 26, T 5 N, R 10 E. M. D. M. for power purposes in NW¼ SW¼ Sec. 26, T 5 N, R 10 E, 13,849 H. P. to be developed. Estimated cost $6,450,000.

Application No. 5129 (Trinity County)—Big Creek Ranch, Inc. care of N. D. Hopkinson, 68 Post St., San Francisco, Calif., for 40,000 acre feet per annum from Big Creek tributary to Hayfork of S. Fork Trinity River to be diverted in Sec. 6, T 32 N, R 11 W, M. D. M. for irrigation purposes on 22,000 acres in T 31 & 32 N, R 10, 11 & 12 W, M. D. M. Estimated cost $200,000.

Application No. 5125 (Placer County)—Victor T. Mathews, Cisco, Calif., for 200,000 acre feet per annum from North Fork American River tributary to American River to be diverted in Sec. 28, T 18 N, R 17 E, M. D. M. for agricultural purposes.

Application No. 5123 (Nevada County)—C. S. Wheeler, Wheelerville via Reno, Nevada, for (1) 500 cubic feet per second and (2) 75,000 acre feet per annum from (1) Truckee River and (2) Little Truckee River tributary to Pyramid Lake to be diverted in (1) Sec. 28, T 18 N, R 17 E, and (2) Sec. 4, T 18 N, R 17 E, M. D. M. for power purposes in NW¼ SE¼ Sec. 34, T 18 N, R 17 E, M. D. M. 11,023 H. P. to be developed. Estimated cost $800,000.

Application No. 5124 (Nevada County)—C. S. Wheeler, Wheelerville via Reno, Nevada, for 75,000 acre feet per annum from Little Truckee River tributary to Truckee River to be diverted in Sec. 4, T 18 N, R 17 E, M. D. M. for irrigation purposes on 20,000 acres. Estimated cost $600,000.

Application No. 5120 (San Joaquin County)—Jack & Sol. D. Klein, care of Ohm & Raab, 517 E. Market St., Stockton, Calif., for 4.19 cubic feet per second from Middle River tributary to San Joaquin River to be diverted in Sec. 1, T 1 S, R 4 E, M. D. M. for irrigation purposes on 335.4 acres in Secs. 6 & 7, T 1 S, R 5 E, Secs. 1 & 12, T 1 S, R 4 E, & Sec. 36, T 1 N, R 4 E, M. D. M. Estimated cost $3,500.

Application No. 5121 (San Joaquin County)—M. G. Oliveira, care of Ohm & Raab, 517 E. Market St., Stockton, Calif., for 4.70 cubic feet per second from Burns Cutoff tributary to San Joaquin River to be diverted in Sec. 12, T 1 N, R 5 E, M. D. M. for irrigation purposes on 377.6 acres in Secs. 13 & 14, T 1 N, R 5 E, M. D. M. Estimated cost $6,000.

Application No. 5109 (Butte County)—James D. and Mary Louise Phelan, Phelan Bldg., San Francisco, Calif., for 3000 acre feet per annum from (1) Philbrook Creek and (2) Butte Creek tributary to Feather and Sacramento Rivers to be diverted in (1) Sec. 16, T 24 N, R 4 E, and (2) Sec. 4, T 21 N, R 2 E, M. D. M. for irrigation purposes on 2080 acres of rice in Secs. 12 & 13, T 21 N, R 2 E, and Secs. 19, 24 & 25, T 21 N, R 1 E, M. D. M.

Application No. 5110 (Butte County)—Parrot Investment Co., 155 Montgomery St., San Francisco, Calif., for 3,000 acre feet per annum from (1) Philbrook Creek (2) Butte Creek tributary to Feather and Sacramento Rivers to be diverted in (1) Sec. 16, T 24 N, R 4 E, and (2) Sec. 4, T 21 N, R 2 E, M. D. M. for irrigation purposes on 16,160 acres in T 21 N, R 1 W, & T 20 N, R 1 W, M. D. M.

Application No. 5091 (Tehama County)—P. B. Cross, Bank of Italy, San Francisco, Calif., for 150 cubic feet per second, and 12,000 acre feet per annum from Deer Creek tributary to Sacramento River, to be diverted in Section 29, T 28 N, R 5 E, M. D. M., Sections 10 or 16, T 27 N, R 4 E, M. D. M., for power purposes in Section 5, T 25 N, R 2 E, M. D. M. or Section 5, T 26 N, R 3 E, M. D. M., 35,795 T. H. P. *or* 18,750 T. H. P. to be developed. Estimated cost $1,800,000.

Application No. 5102 (San Joaquin County)—Henry Peter & Anna Catherine Ponkendref, care of Ohm & Raab, 517 E. Market St., Stockton, Calif., for 3.0 cubic feet per second from San Joaquin River tributary to Suisun Bay to be diverted in Sec. 21, T 1 N, R 6 E, M. D. M. for irrigation purposes on 270 acres in Secs. 16, 17, 20 and 21, T 1 N, R 6 E, M. D. M. Estimated cost $4,000.

Application No. 5103 (Nevada & Placer Counites)—Nevada Irrigation Dist., care of C. F. Meteer, Calif. State Life Bldg., for 125,000 acre feet per annum from Bear River tributary to Sacramento. River to be diverted for purposes in Nevada Irrigation District.

Application No. 5104 (San Diego County)—Ernest W . Cuff, care of Thomas H. King, 920 8th St., San Diego, Calif., for 1.0 cubic feet per second from Cascade Creek tributary to Santa Ysabel Creek to be diverted in Sec. 18, T 12 S, R 4 E, S. B. M., for domestic purposes and irrigation on 100 acres in said Sec. 18. Estimated cost $5,000.

Application No. 5084 (Monterey County)—Geo. C. Humes, M. Simonoff and Wm. C. Lyon, care of Hankins & Hankins, 918 Pacific Bldg., San Francisco, Calif., for 4.22 cubic feet per second and 236 acre feet per annum from Encinal Creek, Milpitas Creek and Arroyo Seco, tributary to Salinas River, to be diverted in Sections 4 and 18, T 21 S, R 5 E, M. D. M., Section 12, T 21 S, R 4 E, M. D. M., for irrigation, domestic, boating, swimming, fishing and fish hatchery purposes in T 21 S, R 5 E, M. D. M. Estimated cost $25,000.

Permits Issued

Among the more important permits to appropriate water issued by the Department of Public Works, Division of Water Rights of California, during the month of July, 1926, were the following:

Permit No. 2580, Application No. 5048 (San Joaquin County) Issued to Helen H. Cleghorn, Stockton, Calif., July 28, 1926 for .22 cubic feet per second from Fourteenmile Slough in Section 16, T 2 N, R 6 E, for irrigation of 18 acres in Sec. 16 and 17. Estimated cost $2,500.

Permit No. 2581, Application No. 4909 (Siskiyou County) Issued to Montague Irrigation Dist., Montague, Calif., July 29, 1926 for 2.3 cubic feet per second from Little Shasta in Section 26, T 45 N, R 5 W, for municipal purposes of Montague, Calif. Estimated cost $8000.

Permit No. 2582, Application No. 4912 (Siskiyou County) Issued to Montague Irrigation Dist., Montague Calif., July 29, 1926 for 50 cubic feet per second from Little Shasta River in Section 26, T 45 N, R 5 W, for irrigation of 17,150 acres within said district. Estimated cost $300.

Permit No. 2566, Application No. 4864 (Yuba County) Issued to Ellen M. H. Lewis, Piedmont, Calif., July 13, 1926 for 3.85 cubic feet per second from Nigger Jack Slough in Section 12, T 15 N, R 3 E, for irrigation of 308.36 acres near point of diversion.

Permit No. 2560, Application No. 4862 (Butte County) Issued to T. L. Quigley, Sutter Club, Sacramento, Calif., July 6, 1926 for 20 cubic feet per second from Lateral "A" Drainage Canal of Reclamation Dist. 833 in Section 4, T 17 N, R 1 E, for irrigation of 892 acres of rice near point of diversion. Estimated cost $5000.

Permit No. 2561, Application No. 4887 (Butte County) Issued to Estate of C. M. Faris, Gridley, Calif., July 6, 1926 for 13.27 cubic feet per second from Lateral "A" Drainage canal of Reclamation Dist. 833 in Section 19, T 18 N, R 2 E, for irrigation of 591.2 acres of rice near point of diversion. Estimated cost $2000.

Permit No. 2575, Application No. 4946 (Tuolumne County) Issued to California Sales Organization, Oakdale, Calif., July 23, 1926 for 0.25 cubic foot per second from Calder Creek in Section 17, T 2 N, R 16 E, for irrigation of 21 acres and domestic and fish culture in Sec. 17. Estimated cost $10,000.

Permit No. 2578, Application No. 3532 (Los Angeles County) Issued to San Dimas Water Company, San Dimas, Calif., July 27, 1926 for 2150 acre feet per annum from Puddingstone or Walnut Creek in Section 10, T 1 S, R 9 W, for domestic and irrigation of 1927.21 acres in the San Dimas and Charter Oak Dists. Estimated cost $160,000.

Power Developments

The Federal Power Commission at its last meeting authorized the issuance of the following licenses:

Project No. 95. To Emma Rose, Anna G. Lane, and Hobart Estate Company, of San Francisco, a license for 25 years for a project or Highland Creek in Tuolumne and Alpine Counties, California, partly within the Stanislaus National Forest. A dam about 80 feet in height will be built across Highland Creek, forming a reservoir of about 9,000 ace feet capacity, to be known as the Spicers Meadows Reservoir. This storage of water is necessary to provide for future growth in domestic and irrigation requirements and to augument the water supply to the applicants' existing power plants. The power proposed to be developed will be used in mining and public-utility service.

Propect No. 567. To East Bay Municipal Utility District, of Oakland, a license for 50 years for a proposed power project in Amador, Calaveras, San Joaquin, and Contra Costa Counties, California, to consist of a dam know known as the Lancha Plana Dam, a reservoir, water conduits, a power house equipped with two 5,000 horsepower generating units, and a transmission line about 82 miles in length. The dam will be of the variable radius type approximately 345 feet in height, forming a reservoir with a storage capacity of about 237,000 acre feet. The storage is intended primarily for municipal water supply purposes. The water conduits will consist of three tunnels, each about eight feet in diameter, with a total length of 26,900 feet, and 442,000 feet of 5-foot steel pipes. The transmission line will be of the steel-pole construction type and will operate at 66,000 volts.

Project No. 593. To J. W. Preston, Jr., of San Francisco, a preliminary permit for 18 months for a power project on the Moke-River, the North Fork of Calaveras River, and their tributaries, in Calaveras County, California. The proposed scheme of development will consist of three interconnected power systems. Power system No. 1 will comprise a diversion from the South Fork of Mokelumne River westward into the North Fork of the Calaveras, with a storage below that point in the McCaty Reservoir, from which a conduit will lead to power house No. 1. Power system No. 2, will consist of a diversion from the South Fork of the Mokelumne at a point two miles above its junction with Middle Fork to power house No. 2 on the main stream, located about three miles below the junction of North and Middle Forks. Power system No. 3 will be supplied from a reservoir on the Middle Fork of the Mokelumne 1¼ miles above the mouth of Bear Creek through a conduit leading to a power house on the South Fork of the river, to be situated near the town of Railroad Flat. The power to be developed will be used by the applicant for irrigation or sold to other interests.

Projects Nos. 649 and 651. To George B. McClary, of Chicago, preliminary permits for two years each for power projects in the Rock River, in Ogle and Lee Counties in the vicinity of Grand Detour, and in Winnebago County in the vicinity of Latham Park, Illinois. The proposed development for Project No. 649 will consists of a reinforced concrete dam protected by an earthen dike on the east abutment and a power house integral with the concrete section of the dam. The power capacity of this project is estimated as 2,000 horsepower, and the head at 9 feet. Project No. 651 will include a reinforced concrete dam with

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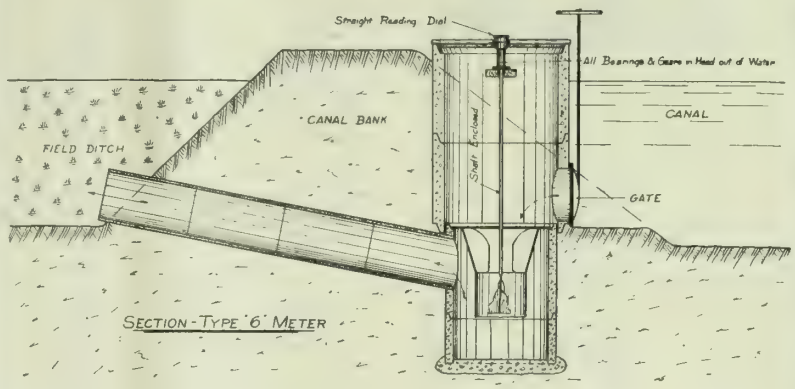

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earthen dikes protecting the east and west abutments with a canal or headrace leading to a power plant a half mile below the dam. The estimated power capacity of this project is 2,160 horsepower and the head 13.4 feet. The developed power is intended for public-utility service.

Project No. 676. To Ray K. Holland, of Ann Arbor, Michigan, a preliminary permit for two years for a power project on the Fox River, in LaSalle County, Illinois. The project provides for the construction of a dam at Wedron creating a head of about 30 feet with a power house having an installed capacity of 2,000 horsepower. The power capacity is estimated to be 860 horsepower. The power, when developed, will be used for public-utility service.

Project No. 681. To the Illinois Northern Utilities Company, of Dixon, a preliminary permit for two years for a proposed power development in Rock River, in the vicinity of Byron, Ogle County, Illinois. The applicant proposes to construct a reinforced concrete dam about 39 feet high and 223 feet long flanked by earthen embankments, making the total length of the dam approximately 11 miles to Rockford, and will have an estimated storage capacity of 1,100 acre feet. The power house will be built integral with the dam and will have an installed capacity of about 1,600 horsepower. The power is intended for public-utility use.

Project No. 621—To the Inland Power & Light Company of Portland, Oregon, a license for 50 years for a power project on the Clearwater River near Lewiston, in Nez Perce County, Idaho. The project includes the construction of a dam and dikes creating a log pond of about 600 acres, a power house, and two transmission lines connecting at the project boundary to a power system supplying public-utility service. The average static head at the power plant is 34 feet, and the estimated power capacity 8,500 horsepower. The proposed ultimate installation will be 10,880 horsepower.

Project No. 588—To the Northwestern Power & Light Company of San Francisco, California, a license for 50 years for a power project on the Elwha River, in Clallam County, Washington, to consist of a reservoir of approximately 20,000 acre feet of usuable storage to be created by a concrete-arch dam 195 feet high, a tunnel 530 feet long, a power house, and a transmission line connecting with the company's existing transmission system. The head on the plant will be 186 feet and the power capacity 8,600 horsepower. The proposed ultimate installation is 16,550

Project No. 608—To Messrs. Giffen, Porter, Pearsall, Freeman, and Knapp, of Los Angeles, a preliminary permit for two years for a proposed power project on the North Fork and the East Fork of the North Fork of Trinity River, in Trinity County, California. The scheme of development provides, first—for the construction of a reservoir on the North Fork of the river which will have a usable storage of approximately 65,000 acre feet, a conduit which will cross the divide between the North Fork and the East Fork of the river near the reservoir into a tunnel and continue down the East Fork to a power house. The total length of the conduit will be eight miles, the proposed installation 20,000 horsepower, and the probable static head on this plant 850 feet. Second—the construction of a reservoir on the East Fork of the North Fork with a usable capacity of approximately 25,000 acre feet, six miles of conduit, and a power house with an installed capacity of 20,000 horsepower located on the same stream, It is proposed to use the power generated for mining and public uses.

OREGON

Among the more important applications for permit to appropriate water filed in the office of Rhea Luper, State Engineer of Oregon, during July, 1926, were the following:

Squaw Creek Irrigation District of Sisters, covering the appropriation of water from Lake Creek & Suttles Lake for irrigation of 16,000 acres. No estimate of cost given.

Also the Squaw Creek Irrigation District applies for the appropriation of 19,000 acre feet from underground waters feeding Blue Lake for storage for irrigation.

Eastern Oregon Light & Power Company, covering the appropriation of water from Grande Ronde River for the development of 1364 theoretical horsepower, at an estimated cost of $810,000.

Hiram Swank of Vancouver, Wash. covering the appropriation of snow water from Blue Bird, Griffin and Washington Gulches, tributary of Powder River for mining in Baker County, at an estimated cost of $2500; also for appropriation of water from Washington Gulch for hydraulic mining at an estimated cost of $1500.

F. B. Ingels of Dufur covering the appropriation of water from Fifteen Mile Creek for irrigation of 24 acres, at an estimated cost of $800.

Roscoe E. Bratton of Grants Pass, covering the appropriation of water from West Fork Jones Creek for irrigation of 15 acres, at an estimated cost of $4500.

J. H. Maxwell of Lewis, Wallowa Co., covering the appropritaion of water from Chesninimus, Gooseberry & Butte Creeks for irrigating of 43 acres.

J. M. Thompson of Camas Valley covering the appropriation of water from a tributary of Mid. Fork of Coquille for irrigation of 25 acres at an estimated cost of $500.

W. G. Wilson of Salem, covering the appropriation of water from three springs for irrigation of 4 acres, at an estimated cost of $200.

P. J. Larson of Portland, covering the appropriation of water from springs and spring creek tributary to Bucannoun River, for irrigation of 4 acres, and supplying water for hydraulic ram and auto camp, in Clatsop County.

E. Beauregard of Hood River, covering the appropriation of water from Spring, tributary to Neal Creek, for irrigation of 35 acres, at an estimated cost of $500.

B. C. Terry of Enterprise, covering the appropriation of water from Silver Creek for irrigation of forty acres.

S. S. Myers of Waurna, covering the appropriation of water from Bee Lake Creek for power plant in Clatsop County, at an estimated cost of $750.

E. L. & C. C. Dickson, covering the appropriation of water from Calapacia River and Ash Slough, for the irrigation of 284 acres in Linn County.

Albert E. Hill of Sutherlin covering the appropriation of water from Calapacia Creek for irrigation of 120 acres.

D. C. Flanagan, E. J. McHugh & William Robitsch covering the appropriation of water from an unnamed tributary of Wilson for mining in Tillamook County, at an estimated cost of $400.

Lydia E. Dean of Grants Pass, covering the appropriation of water from Rock Gulch for mining, for irrigation, at an estimated cost of $200.

Thos. Ogden of Grants Pass, covering the appropriation of water from Shan Creek for irrigation of 10 acres.

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(*Continued from Page 21*)

valuable information, a revised and up to date membership roster of the Western Irrigation Equipment Association has been authorized.

The membership committee presented five new applications for membership, all of which were favorably received, and the meeting was then turned over to the well drillers, for a discussion of their problems and the formulation of a plan of action designed to be of some practical assistance to this industry.

The next meeting, which will be the regular annual meeting, will be occupied chiefly with the election of officers. The meeting is scheduled for September 8, at the Sacramento Fair Grounds.

Announce A.W.W.A. Program

(*Continued from Page 17*)

M., automobiles will leave for trip to Lower Otay Dam and other points of interest of the San Diego Water System. Lunch will be served as guests of the City of San Diego at the Lower Otay Filter Plant. Return to hotel about 4:00 p. m. Ladies invited.

SPECIAL ENTERTAINMENT FOR LADIES

Thursday, Afternoon: Excursion on San Diego Bay.

Evening: Theatre party.

Friday: Automobile trip through parks and Point Loma.

Editors to Back Boulder Dam

A resolution approving the Boulder Canyon dam project and pledging support for legislation before congress was adopted by the National Editorial Association in their annual convention in Los Angeles the early part of last month. The editors had ample time to see what irrigation has done for parts of the west when they visited a number of the projects and farms. Frank C. Edgecombe, of Geneva, Nebraska, president of the association, suggested to the editors that they voice their approval of the project.

Correction in Table

MODERN IRRIGATION announces that an error was made on page 32, table one, fourth column, in the July issue. The fourth column and an additional column of this table should have read as follows:

Well	H_2S PPM	Iron PPM
City No. 1	9	0.3
Gold Seal No. 1	8	0.3
Gold Seal No. 2	15	0.3
Gold Seal No. 3	5	1.0
Willows No. 1	4	0.2
Willows No. 3	0.5	0.1
Willows No. 4	0.5	0.05
Beverly Vista No. 1	20	.....
Tatum No. 1	4	.....
Preuss No. 1	11	.....
La Cienega No. 1	6	0.1
Franklin No. 5	0	0
Franklin No. 9	0	0

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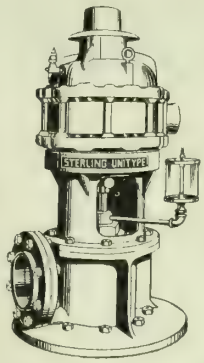

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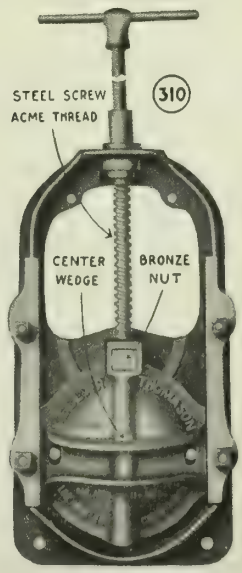

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AMONG OUR CONTRIBUTORS

Editorial Jottings About Current and Forthcoming Feature Articles, Dealing With Practical Problems of Hydraulics, and the Men Who Have Written Them

CHARLES A. JENSEN attended college at the universities of Utah and Nebraska. He has spent some 15 years in the U. S. Department of Agriculture in the bureau of soils and bureau of plant industry. In this line he specialized in alkali and plant nutrition, spending some five years in citrus investigations in and about Riverside, California. In Colorado he studied sugar beet problems when he was with the American Beet Sugar Company. About three years ago he left his position as field superintendent of the National Orange Company, Riverside, California, where he served for four and a half years, and went to the Limoneira of which he writes in this issue.

DR. ELWOOD MEAD needs no introduction to the irrigation fraternity. His position as Commissioner of Reclamation assures any utterances of his careful reading. Born in 1858, he received his C. E. degree from Iowa State College in 1883. From 1883-84 he was a professor in Colorado Agricultural College, and again from 1886-88. He was territorial and state engineer of Wyoming from 1888 to 1899. Later he was chief of irrigation and drainage investigations of the federal government; professor of institutions and practices of irrigation, University of California; chairman of state rivers and water supply commission, Victoria, Australia. For a number of years after 1915 he served as professor of rural institutions, University of California. He has been chairman of the land settlement board, till today he is Commissioner of Reclamation. He is a member of the A. S. C. E. and British Inst. C. E. Among the works that he has written on irrigation is "Irrigation Institutions."

DOUGLAS G. MCPHEE has been executive editor of Modern Irrigation since its inception over a year ago. He "covered" his article while on his new mission with the editorial staff of "Western Advertising."

WILLIAM J. B. STEWART is a consulting hydraulic and overhead engineer who conducts the monthly department of Overhead Irrigation. He also conducts the inquries department of overhead. This department has been opened for the convenience of the profession.

DON J. KINSEY has for some time been connected with the Los Angeles Bureau of Water and Power. He writes the current article after he has "gone through the battle" with the Owens project. His chief work consists of gathering data and material for the profession on the Los Angeles Water and Power bureaus.

PHILIP J. HASBROUCK, who writes about Fontana, was graduated from Cornell University in 1896 with a degree in Mechanical Engineering. From college he went to the Pittsburgh district to spend some ten years in the steel industry as engineer, constructionist, and operator. In 1908 he came to California and has since been connected with engineering work related to water supply and irrigated lands.

Wartimes found him a captain of field artillery in France, while he is now a major of field artillery in the organized reserves.

Since 1925 he has been in Fontana in charge of water development and operation of irrigating and domestic water systems. He is a member of the San Bernardino chapter of A. A. E., having at one time been president of that chapter.

MILO B. WILLIAMS, who writes about concrete pipe in the hydraulic engineering department of this issue, is retained as consulting engineer by the California Associated Concrete Pipe Manufacturers. In 1917, when the value of concrete pipe for irrigation development attracted the attention of the United States Department of Agriculture, Mr. Williams was placed in charge of a study of the manufacture and uses of concrete pipe under the direction of Dr. Samuel Fortier, chief of irrigation investigation at Washington, D. C. The work met with the hearty co-operation of the pipe manufacturers who came to place great confidence in the work that Mr. Williams accomplished. He continued his studies in the years to come and the success that he attained has been such that today he finds himself even more closely allied with some of his former collaborators in government work by his association with the California manufacturers' group as consulting engineer. Mr. Williams had charge of the concrete pipe tests by the California Associated Concrete Pipe Manufacturers conducted at San Jose, California, a few weeks ago and his report of these tests will be published in a forthcoming issue of MODERN IRRIGATION.

THIS month's cover is a reproduction of the architect's vision of the Coolidge Multiple Dome Dam to be constructed shortly in Arizona. MODERN IRRIGATION is indebted to the architects, Wright and Gentry, Long Beach, Calif., for the photograph.

IT IS DIFFICULT to refrain from commenting briefly on a few of the unusual and highly practical articles scheduled by the editor for forthcoming issues of MODERN IRRIGATION. There is in prospect another article of the "What Irrigation Has Done for My State" series, this one having been written by James Graves Scrugham, governor of Nevada, who will tell of the reclamation and irrigation accomplishments in his state, the irrigated area of which, at present, comprises 560,000 acres.

"Irrigation in Mexico" is the title of a broad survey of the Mexican situation that has been prepared for this journal by R. A. Hill, of Quinton, Code and Hill, Los Angeles. Mr. Hill's knowledge of his subject comes from first hand contact with Mexican projects and people, the material for his article having come from personal interviews with President Calles, ex-President Obregon and members of the Mexican reclamation and irrigation committee. Many of the intensely interesting facts brought out by Mr. Hill in this paper have never before appeared in print.

OTHER EQUALLY vital subjects are to be covered by competent irrigation authorities in coming issues, but rather than devote more space to announce the nature of these articles, it might perhaps be best to adopt the method of the drama reviewers and not tell too much.

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For 12 Months: $2.00; Single Copies: 20 cents.

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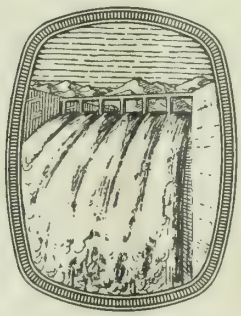
HERBERT HOOVER

Who came out of the east last month to view the developments in reclamation and irrigation that have transpired since his last western tour; and who came, too, to re-affirm more strongly than ever his creed of water development in the United States. Mr. Hoover urges that we consider all water projects as one comprehensive national undertaking, basing his plea on the fact that every major water development must benefit *all the people* and should therefore receive universal support. Politics and litigation, he explains, "create much feeling over water development, but not much development."

MODERN Irrigation
The Magazine of Applied Hydraulics



Volume II SEPTEMBER, 1926 Number 9

The Progress *of* Irrigation

TWO men from Washington have recently given to the west their views on reclamation and irrigation, one speaking from the standpoint of the engineer and the other taking the view of the economist. The men are Herbert Hoover and Dr. Elwood Mead, both of whom have been on the Pacific Coast during the summer.

Hoover, an eminent engineer, has said after a tour of inspection of the western projects, that the time has come when we must take an enlarged vision of the future development of the water resources of the country. His view of the future is almost staggering to the irrigator who sees only his own problems and his own needs in enlarged perspective and fails to grasp bigger needs and problems that affect the whole country's water development. As Hoover himself puts it, "We must no longer think in terms of single power sites or single storage dams or single land projects, or single irrigation improvements; we must think (and thanks to science and engineering we can think) in terms of the co-ordinated, long-view development of the national water resources."

He touches, too, on the regrettable fact that the possibilities of such development are "fast drifting into the muck of litigation, political opposition, and interstate quarrels which could be solved by the determination of broad national programs." He has told his audiences in the west that sectional controversies settle nothing, and engineer-like has added, "Water development can be settled only by steam shovels and the pouring of concrete."

It is important to remember one thing that Hoover himself points out in reference to any broad national program of water development; namely, that such development could it be completed tomorrow, would put under cultivation large areas of land that would bring about overproduction; but he asks us not to overlook that such development will take many years, that the population of the United States will be increased by 40,000,000 people in the next quarter of a century, and that before the big projects now under discussion can be completed efforts will have to be made to provide food for that increase. The program that Hoover outlines, if started at once, could not affect agriculture for fifteen years, he says.

Dr. Elwood Mead, Commissioner of Reclamation, has also given an interest-

ing viewpoint on federal reclamation. Dr. Mead has called attention to the fact that while the engineering achievements of the bureau of reclamation demonstrate that it has both the integrity and the ability to carry out its complex and difficult task, many of us are still holding to what he calls the "erroneous and dangerous idea" that reclamation can be made a success if we leave settlement and farm development to take care of themselves.

In respect to farm development, he asserts, our reclamation policy is a quarter of a century behind that of other countries. It is true, as he says, that the engineering side of federal reclamation has had all the attention and has therefore attained some considerable measure of success, whereas the economics of farming have been overlooked. Both are fundamental and should, and no doubt will, have equal attention.

Dr. Mead makes the interesting contention that the economic factor of preparing land for irrigation is not so much a farming operation as an engineering operation. There is logic to his assertion that preparing land for irrigation is a part of construction and ought to be so regarded, for the settler is as a rule used to methods of farming employed in a humid section, and is not equipped physically or financially to do the preparatory work on the irrigated farm. A carefully thought-out program for making farms ready for cultivation will attract more and better farmers to new projects.

Here then is the pressing problem of federal reclamation; but with the problem recognized and with the better forces for agriculture interested in it there is every reason for an optimistic viewpoint. The solution may not be just around the corner, but it surely is in sight.

As progress accounts and accounts of new projects are chronicled from day to day, one is impressed with the thought that the Pacific Southwest is barely on the threshold of achievement, despite its miraculous growth. It must be judged, not by what it is, but by what it is destined to be. Population is growing faster than the average—greater and greater demands are made upon the productiveness of the cultivated areas—and it has become a matter of immediate importance to lay constructive plans for the future development of California's greatest resource—water.

Irrigation means new wealth, new resources, new land for settlement, new opportunities for the farmer. By means of irrigation the Pacific Southwest will be able to meet the constantly increasing demands of this country's fast growing population.

In California alone, so successful has been development of irrigation, that in the past 35 years, the agricultural production has jumped from $90,000,000.00 to more than $600,000,000.00 with a consequent tremendous increase in the value of the farm land. And so successful has been its development, that the annual value of the crops raised through irrigation now exceeds the total investment in irrigation projects.

In California alone, there are 96 active irrigation districts comprising an area of some 4,000,000 acres. In addition, the United States Reclamation Service operating on a huge scale has added to the productiveness of the West through 28 separate enterprises that have been successfully negotiated. More than 480,000 people now live on some 37,000 farms created and irrigated by government enterprise, according to an estimate made by Commissioner Elwood Mead in his Lake Tahoe address in June of this year.

A total of 1,692,700 acres of land have thus been added to the solid foundation upon which Western business can be profitably built.

On to San Diego!

OCTOBER 28, 29, 30, are the dates for the seventh annual convention of the California section of the American Water Works Association. The convention will be held in the San Diego Hotel at San Diego, California. Waterworks authorities and others well known to the profession are on the program, the details of which are already well known to waterworks engineers through their publication in the August issue of Modern Irrigation.

Those who attended last year's convention have happy memories of that occasion, both from the standpoint of the practical benefits derived from the program and the recreation from daily cares made possible through the thoughtfulness of the entertainment committee. This year's meeting, in the words of Sinclair Lewis' Babbitt, has all the earmarks of being "a bigger and better" convention.

Final arrangements for the three-day session will be published in the October issue—or first annual Water Works issue—of Modern Irrigation. Both the October and the November issues will be big waterworks numbers, however, as a complete account of the convention will be carried in the latter number.

DR. W. L. POWERS

Feasible or Not?—What are the Factors that Decide?

Political, Physical, Social and Economic Considerations Must be Properly Weighed in a Survey of Any Irrigation Enterprise

By DR. W. L. POWERS*

IN THE EARLY development of irrigation, engineering problems were given major attention. A more or less new concept was accepted, when, ten or twelve years ago, public opinion was thoroughly aroused to the necessity of giving careful attention to soil and agricultural conditions; as a result of which soil and agricultural feasibility surveys came into demand. Recent conditions have re-emphasized this newer idea. The unprecedented agricultural depression of the past few years, with low crop values on the one hand and increased cost of fitting and equipping irrigation farm units on the other, has increased the relative importance of economic surveys on proposed projects, and of readjustments in an economic way on existing reclamation enterprises.

The need and use of such surveys is well illustrated in Oregon. There has been a heavy demand for assistance from the Oregon Experiment Station in making soil and economic feasibility surveys and more than 3,000,000 acres of land in proposed reclamation enterprises, including irrigation and drainage propositions, have been examined. Unfortunately, the time and means available for these surveys for the most part have been only sufficient to permit general surveys to be made.

These surveys have included a general soil survey with the aid of the topographic base map furnished by project engineers to determine the extent and characteristics of the different types of soil on the project, their usable water capacity, general fertility, reaction and net water requirements. Attention has been given to climatic conditions, crops suitable, and average probable yields, and to the size of farm unit, type of agriculture, and probable productive value of the land under irrigation.

Survey a Pre-Requisite

In the open country in eastern Oregon, a reasonable productive land value per acre is $25 to $33 per acre for each ton of alfalfa raised on an acre in a year; i. e., 3-ton land may be worth $75 to $100 per acre. Preliminary engineering and soil surveys as well as detailed studies should go hand in hand. Often it has been possible to modify the outlines of the project substantially in order to include the most irrigable land and eliminate the land that is rugged, stony, shallow, and more alkaline.

From the experience gained through these surveys, it is felt that future surveys should be detailed farm unit surveys that will show the number of acres of different classes of irrigable land on each farm. The methods to be employed by state, federal, or professional persons undertaking such work may perhaps be more clearly defined at this time and the factors affecting the feasibility and success of a reclamation project will be briefly described here in the hope of giving a clear concept of this work.

The factors affecting feasibility of reclamation projects may be grouped under four headings; namely, physical, economic, social, and political.

Political Factors Important

Political factors and policies may affect the value of land and water. A united community that is permeated with a spirit of pluck, determination, and enterprise is a great psychological asset to any project.

Social factors affecting the value of land and water include racial types, religious creeds, and social, class and recreational facilities.

The physical factors affecting the value of land and water will include, besides the engineering features, the soil, topography and drainage, as well as climatic and health conditions.

The most important property of the soil, from the irrigation standpoint, is its usable water capacity. Good depth, smooth topography, and good natural drainage, as well as loamy texture are important. A neutral reaction, or freedom from alkali, and freedom from killing frosts, as related to the drainage conditions, are important, as is also the healthfulness of the project. A large supply of organic matter and plant foods is desirable, but these can be supplemented, if deficient.

A soil, however good, may be inactive unless man uses it. The American Indians had access to the same soils as are available to the use of the present generation. It required Yankee enterprise to develop and utilize the soil and water resources of the nation. The west's main opportunity for development is through the irrigation and peopling of its arid lands.

Anatomy of Soils

Soils may be compared to folks. The mineral fraction of the soil constitutes its skeleton, the clay material its fleshy coating or lining, and the soil solution its circulatory system. Soils must have aeration, they digest organic matter, and, finally, there must be elimination to avoid the accumulation of alkali or toxins.

Most soil treatments are aimed at regulating circulation, respiration, or nutritional conditions in the soil. Irrigation and drainage regulate the circulatory system of the soil. Soils have youth, maturity and age. The maturing and aging of soil under arid and semi-arid conditions gives rise to different layers, or horizons, which may be compact, fine textured, or tight in nature.

The high lime contents of these arid and semi-arid soils are favorable to continued production. The readiness with which soil-building legumes are grown under irrigation affords ready means of keeping up the productiveness or of extending the age or life of a soil. Proper

(*Continued on Page 28*)

*Dr. Powers is in daily contact with the problems of agricultural feasibility surveys by virtue of his position with the Agricultural Experiment Station of the Oregon Agricultural College.

Navajoa, Sonora—a representative Mexican community. The plaza, hub of social and business life, may be discerned at the left center. The offices of ex-president Obregon (1) and his private home (2) have been marked for identification. In the background, the Mayo river, now the subject of active irrigation development.

R. A. Hill Discusses the Yesterday, Today and Tomorrow of Irrigation

IN MANY of its irrigation practices, developed through centuries of dependence upon artificial regulation of water supply, Mexico is able to teach its northern neighbors valuable lessons.

How far irrigation had been developed, or whether it had been practiced to any considerable extent, when the conquering Spaniard came to Mexico and took the country from its aboriginal inhabitants, it is hard to say. It has now been practiced for so many hundreds of years that it is impossible to determine, and not particularly vital, whether its principles were imported from semi-arid Spain, or whether some rudimentary application of irrigation was known before the advent of the conquistadores.

The physical division of Mexico is largely one of altitude. It is possible to start at Vera Cruz, on the east coast within the true tropics, and to pass through a country of temperate clime, while snow-capped mountains are visible from the windows of the train.

Aside from the influence of elevation, there is a wide diversity in the amount of rainfall. Practically all of Mexico receives most of its rainfall during the summer season, as is typical of countries within the tropics. Consequently, although there is a comparatively large annual rainfall throughout much of Mexico, excepting the northwest and the *Mesa Central,* the rainy season is so short that some artificial means is essential for the furtherance of agriculture.

Important to the United States

Along the west coast, and particularly between Guaymas and Tepic, there is an immensely productive region whose future development depends largely upon the construction of storage works. This portion of Mexico is closest to our own Pacific Coast, and its development is of the greatest importance not only to Mexico but to the United States as well. Along the east coast the distribution of rainfall is somewhat more uniform, so that irrigation from unregulated streams has been practicable.

Laws and customs have naturally grown up regarding the use of waters from the rivers which even today are as advanced and in many instances more practicable than the laws in force in many of our states.

The Mexican law of appropriation of the waters of any stream may be considered the foundation of the law of appropriation which holds in Arizona and to some degree in California and other States. The riparian law, which was developed in countries where no lack of water existed, was passed down to us from the English settlers of the United States and is far less applicable to the semi-arid regions than is the Mexican law of appropriation.

Under Federal Control

In Mexico the control of the waters is very largely in the hands of the federal government, rather than under the direction of the individual States. This is a natural outgrowth of the political history of the country which until a few years ago was known as the Republic of Mexico, and only recently became the United States of Mexico.

A law has recently been passed which provides for the irrigation of lands by the federal government. The *Comision Nacional de Irrigacion,* created by this act, resembles in many respects the Bureau of Reclamation of the United States.

The Yaqui River winds through treeless banks, typical of Mexican streams.

Typical Mexican scenes, reflecting the primitive conditions. ABOVE: An adobe casita, where the Mexican peon lives, with family, dog, pig, rooster and hens. BELOW: Peon laborers working on the construction trestle for a diversion dam on the Yaqui River, state of Sonora.

Mexico

Has practiced irrigation for centuries, yet is far behind the United States in the development of irrigation enterprises on a co-operative basis.

Has laws affecting irrigation which are more practicable and successful than the confused water laws in the United States.

Has patterned her recently created Comision Nacional de Irrigacion after the United States Bureau of Reclamation.

Is attempting a new policy of governmental development based on a pay-as-you-go principle, calculated to make irrigation projects financially solvent and increase government land holdings.

Must depend largely upon colonization for future success, for the native is not usually a good farmer.

in the Land of *Mañana*

The Federal Government of Mexico had for an example the situation in the United States, wherein the settlers have not and in many cases probably will not reimburse the government for expenditures entailed in the construction of irrigation projects. The new irrigation law of Mexico, therefore, provides for the payment to the government of the cost of construction at the time that the construction is executed.

It is provided that repayment will be effected by the landowners turning over to the government enough of their land to meet the cost of development. According to the terms of the act, the capital of no individual will be reduced. For example, if a landowner has a thousand acres the potential value of which is $50,000, he will be allowed to retain that amount of land which, at its face value after irrigation is developed, will aggregate the same amount. That is, if the land is worth $100 per acre after development, he would turn over to the government five hundred acres and would retain five hundred.

The result of the operation of this law will be to place in the hands of the government a large amount of land within each of the irrigation projects which it undertakes.

Within Mexico there is no public land, as we in the United States consider public land. There has been, therefore, no opportunity for the people of Mexico to acquire land except by purchase from private owners. These private holdings date back to the original Spanish grants, and in many cases are of tremendous extent. This control of the land of Mexico was one of the fundamental causes of the revolution, and it has been the aim of the government to make possible the division of land among its people.

Devise Credit System

The lands which the Government takes over within the irrigation projects, in reimbursement for money expended on construction of irrigation works, will be sold to citizens of Mexico, or to those who declare their intention to become citizens. It is generally recognized that only a very limited number will be able to purchase this land outright. There has been established in Mexico, however, the *Banco de Credito Agricola,* (Agricultural Credit Bank) which in many respects is similar to our Federal Farm Loan Bank. Through the agency of this bank selected individuals with little or no capital will be able to purchase and develop these government lands.

The primitive is always picturesque. This Mexican maiden is doing her matutinal duties in an age-old way.

Although the federal government of Mexico is now investigating various projects under the terms of the irrigation law, construction has not yet started on any project, so that it is impossible to express any opinion as to the operation of the law. The operation of the new law does not preclude private development. In fact, it provides that the government will take over private projects only upon failure of the private interests to effect the development.

The methods employed in the irrigation of lands in

(*Continued on Page 22*)

A busy scene at harvest time on a California ranch. The tenant farmer in the West represents a large proportion of the agricultural population, but in many cases the tenant is among the most progressive and successful ranchers of the community

Farm Tenancy in the Irrigated West

Ever an Important Economic and Social Problem in an Agricultural Community, Tenancy Has a Special Relation to the Great Sections Dependent on Irrigation

By H. E. ERDMAN*

TENANCY is often spoken of as one of the outstanding evils of agriculture. There is a lot of discussion of methods of correcting the evil—whether it be real or imagined. We find that in the United States tenancy has been increasing with every census. The figures for five census enumerations for the whole United States and for several individual states are shown in Table I.

TABLE I—*Per Cent of Farms Operated by Tenants in the United States and in Selected States. Census Years 1880-1920*

Census Year	United States	Illinois	Mass.	S. Dak.	Oregon	Calif.
	%	%	%	%	%	%
1880	25.6	31.4	8.2	4.4	14.1	19.8
1890	28.4	34.0	9.3	13.2	12.6	17.8
1900	35.3	39.3	9.6	21.8	17.8	23.1
1910	37.0	41.4	8.1	24.8	15.1	20.6
1920	38.1	42.7	7.1	34.9	18.8	21.4

Preliminary figures issued by the Bureau of the Census show California with a decline from 21.4 per cent in 1920 to 14.7 per cent in 1925, although there was an increase in the number of farms from 117,670 to 136,409. In other words, there was actually a decrease in tenancy in the face of an increase in the number of farms. I do not have a satisfactory explanation of this phenomenon. Perhaps the Alien Land Law had much to do with it. Perhaps, also, many tenants became owners of farms between 1920 and 1925. It may be that a few formerly tenanted farms are now operated by hired managers. Probably all three reasons are important.

Tenancy is by no means confined to the United States. It is of interest to note the relative proportion of tenancy in various important nations as set forth in Table II.

TABLE II—*Farm Tenancy in Selected Countries*†

Country	Year	Per cent of all farms operated by tenants
United States	1920	38.1
England	1914	88.9
Argentina	1914	38.5
Ireland	1916	36.0
China	1920	28.1
Germany	1907	25.4
Canada	1921	7.9
Japan	1921	28.5
Denmark	1918	8.0

†See article in Yearbook, U. S. Dept. Agr., 1923, pp. 507-600.

In many of these countries there has been more or less discussion of the evils of tenancy, yet no country has as yet succeeded directly in eliminating it.

Why, we may ask, do we have tenancy? Two fundamental facts underlie tenancy as an institution. They are: (1) there must be a change in farm operators on any given piece of land about three times in a century because farmers naturally grow old and drop out as active farmers, and (2) young farmers, except where they inherit wealth at an early age, have no money with which to buy farms.

If our credit machinery were sufficiently flexible we might arrange for every young man to buy who so desired. But that would hardly be wise. Too much inexperience would make for inefficiency. Moreover, there are other reasons why we have tenancy. Let us note some of the more important ones. In the first plae, how and why do persons who cannot or do not want to farm come into possession of farm land? Here are some of the most common reasons:

1. Many persons inherit land.
2. Lenders find that they have to foreclose mortgages.

*Professor Erdman is Professor of Agricultural Economics, Division of Agricultural Economics, College of Agriculture, University of California.

3. Investors buy because they consider land a good and, above all, a safe investment.

4. Speculators buy land because they expect prices to go up.

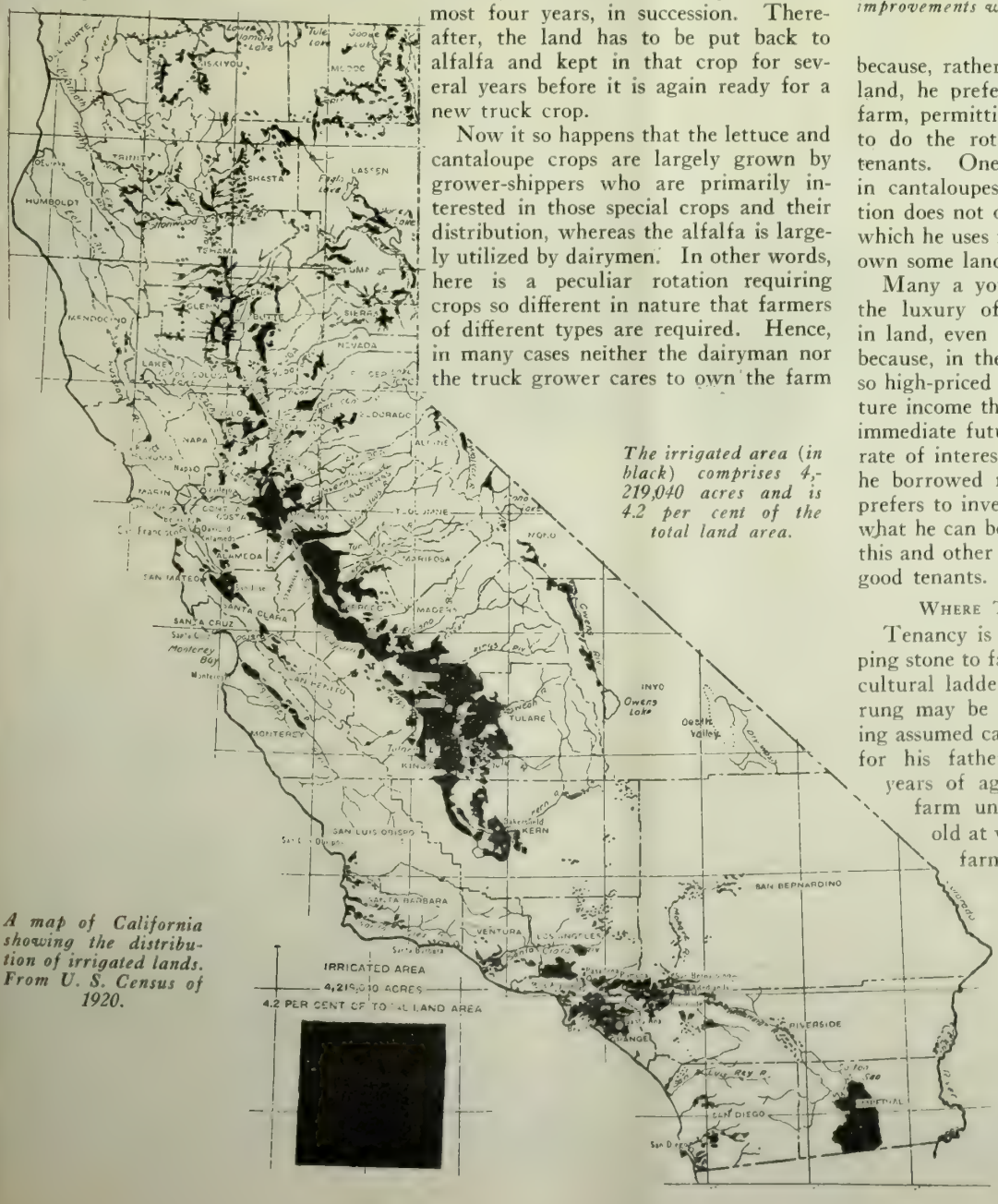
5. Promoters buy because they expect to profit by resale.

Now, all these classes may find that tenancy is the best way for them to handle the land. Operating by hired managers has not, in general, proved successful. The first two classes might sell, but that is not always feasible as it may take time before an estate can be settled. Administrators may not want to take the responsibility of reinvesting funds, and the market for land may be dull. On the other hand the land may be considered a good investment.

So far, we have not mentioned the most important reason. Retired farmers find that tenancy is an excellent way to transfer property to children. A Wisconsin study a few years ago showed that in a community which was probably typical of many in the middle west and elsewhere, nearly half of the rented farms were rented to relatives of the landlord—mostly to sons or sons-in-law.

In addition to the above, there are many peculiar or special reasons for the existence of tenancy. For example, in Imperial County, California, in 1925, 46.7 per cent of all farms were operated by tenants. This is by far the highest figure in any California county and is caused by a peculiar situation in the Imperial Valley. Much of the land there is being used for two main purposes. One is the growing of truck crops, such as lettuce and cantaloupes, which can be grown on the same land for only about two or three years, or at most four years, in succession. Thereafter, the land has to be put back to alfalfa and kept in that crop for several years before it is again ready for a new truck crop.

Now it so happens that the lettuce and cantaloupe crops are largely grown by grower-shippers who are primarily interested in those special crops and their distribution, whereas the alfalfa is largely utilized by dairymen. In other words, here is a peculiar rotation requiring crops so different in nature that farmers of different types are required. Hence, in many cases neither the dairyman nor the truck grower cares to own the farm



The irrigated area (in black) comprises 4,219,040 acres and is 4.2 per cent of the total land area.

A map of California showing the distribution of irrigated lands. From U. S. Census of 1920.

Seven-months-old peach trees on a Delhi (California) ranch, receiving the irrigation so vital to their profitable production. Such improvements will not be undertaken by tenant farmers.

because, rather than to rotate on his own land, he prefers to move from farm to farm, permitting the owner of the land to do the rotating through changes in tenants. One of the largest operators in cantaloupes and lettuce in that section does not own a square foot of land, which he uses for that purpose. He does own some land, but he has that in fruit.

Many a young farmer cannot afford the luxury of investing or speculating in land, even though credit is available, because, in the first place, much land is so high-priced on account of expected future income that he cannot realize in the immediate future anything like the same rate of interest he would have to pay if he borrowed money. Consequently, he prefers to invest all his own capital, and what he can borrow, in equipment. For this and other reasons we have some very good tenants.

Where Tenancy Is Desirable

Tenancy is often spoken of as a stepping stone to farm ownership. The agricultural ladder in which tenancy is one rung may be illustrated by the following assumed case! Suppose a man works for his father until he is twenty-two years of age, then rents his father's farm until he is thirty-two years old at which time he inherits the farm. Suppose that he farms on his own account until he is sixty-two, when he in turn leases to his son. Upon his death, at the age of seventy-two, the farm passes by inheritance to the son. If this were the universal procedure, 25 per cent of our

(*Continued on Page 22*)

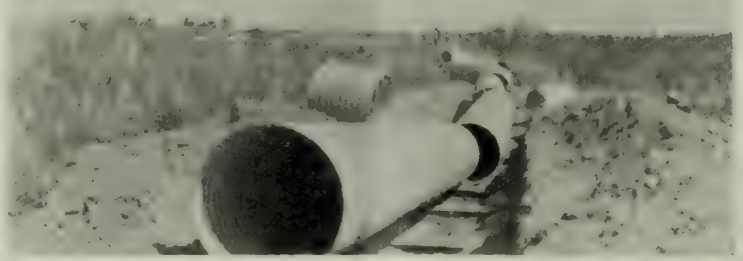
F. W. SLATTERY, *Drainage Engineer*

Tells How

The Imperial District Meets Unusual Drainage Problems

Unique Situation of the Lower-than-Sea-Level District Calls for Ingenious Systems of Drainage of Valley Lands.

ABOVE: The district uses a clam-shell bucket in canal maintenance. It digs a deep, narrow channel, and permits the tules to grow up on each side, shading the ditch and preventing growth in the ditch proper.



LEFT: Drainage activity near the Salton Sea—a line of 18-inch, 14-gauge, close riveted and soldered Armco pipe, ready for installation. BELOW: Lennon type galvanized flumes are used extensively in this work. Interiors of flumes, and exteriors at the joints, are painted for additional durability.

IMPERIAL VALLEY presents to irrigators a problem not encountered on most irrigated projects. As the climate of the valley is one in which crops can be produced during the entire year, the drains are never given an opportunity to develop any appreciable underground storage reservoir, or a chance to get ahead during a season of non-irrigation, but are kept constantly supplied with the excess water from irrigation which is not taken up by plant roots. This, no doubt, has the effect of leaching, except in the districts where the water table is held so close to the surface that capillary action can continue to take place.

The unique situation of the valley, indeed, makes all of its irrigation problems somewhat unusual. That portion which lies within the United States is situated at the extreme southeastern portion of California, and lies some 40 miles west of the Colorado River; also west of a very long range of now quite famous sandhills. The elevation of the valley ranges from about 30 feet above sea level at the international boundary line near the East Mesa to 250 feet below sea level at the edge of the Salton Sea, which marks the northwestern extremity of the valley.

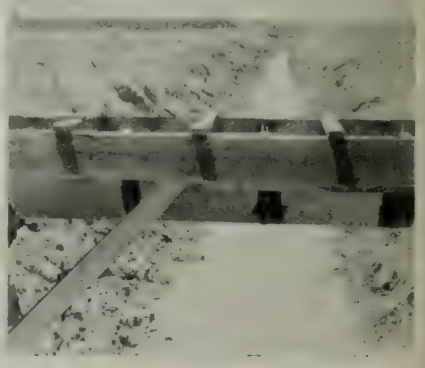
The valley has been built up by periodic overflowing of the Colorado River from its delta to the south into the lower area of the Salton sink. This overflowing has brought in a variety of soils with the very fine silts predominating. The exception is to be found around the rim of the valley where evidences exist of an ancient beach line. In these districts the soil is very sandy and ground water movement is very free. While the floor of the valley is largely composed of the finer, tighter soils, it has been so built up that the strata of nearly impervious materials are invariably broken by strata of sand; it is through these sand strata that the principal ground water relief is obtained.

Portions of the Valley have for several years been provided with quite an elaborate system of wasteways intended to carry off excess surface water. It is in these districts that the largest areas of seeped land were first found. It seems that the fact that means were at hand to care for any extra water caused the irrigators in these districts to be negligent and to let more water pass over and into the soils than was actually required by the crops. The excess water, passing into the soil, quickly built up the water table.

The open type of drain has been used almost exclusively thus far, the reason being that practically all of the first construction was primarily to provide main outlets. The ultimate capacities of the majority of the drains thus far constructed could not be determined due to continually developing seeped areas.

About two miles of tile drains have been built and an additional 4,000 lineal

(Continued on Page 39)



A corner of the campus of the University of California, at Berkeley.

What the Colleges Are Doing for Irrigation in—

Anticipating the Problems of Tomorrow's Irrigators

By S. H. BECKETT

Associate Professor of Irrigation Investigations and Practice, College of Agriculture, University of California

CHEAP WATER development is practically a thing of the past in the West. New irrigation enterprises, developed at large cost, are placed in direct competition with older districts, many of which have been developed at low cost, and with comparatively low maintenance and operation charges. To facilitate meeting this competition, there will be created in the future a much more insistent demand for additional information concerning increased production and decreased production costs.

There are many questions which the irrigator of the future will ask—and will expect to have answered—but in the phase of the problem directly concerning the application of the water to the land, there are four principal queries, generally important to the present-day irrigation, but to be of increasing importance to the irrigator of tomorrow. They are:

1—What quantity of water per acre is required for economic irrigation of the particular crop in question, both at the margin of the farm, and in the soil, as moisture available for plant use?

2—What is the proper frequency of irrigation, and what depth of water should be applied per irrigation, for various crops and various soil types?

3—How can this water be most economically applied, considering the topography of the land, soil type, size of available irrigation head and character of crop grown?

4—How can waste in transportation, delivery and application be reduced, and what conditions govern the practicability of installation of such improvements as ditch-lining, underground or surface pipe delivery systems, modern gates, valves, etc.?

In order to be of greatest service to the irrigator of tomorrow, it is essential that those directing teaching and research in irrigation in the various colleges should anticipate these and similar questions, which represent the most imperative irrigation problems of the future.

Such problems are legion—mainly concerned with economics, but involving a host of questions directly relating not only to the delivery and application of water, but touching also the matter of justifiable expense in land and improvements, marketing facilities, production costs, and so forth.

And what are the colleges doing to answer these questions?

Early Study Inadequate

During the past twenty years, different state and Federal agencies—including western colleges—have had under investigation various phases of these problems. Early investigations, dealing with the economic quantities of water to be applied in irrigation, consisted almost wholly in the measurement of water applied to the project as a whole or to the individual farm, the economic use being obtained by comparing yields to corresponding quantities of water.

These investigations covered a wide range of soil, climatic and crop conditions, each institution interesting itself in the particular phase of the problem which was of the most immediate importance to the agriculture of its own community. These observations naturally showed a wide variation in methods of procedure and the results obtained, although much valuable information resulted in determining reasonable water requirements for various crops. These investigations, however, did not

(*Continued on Page 27*)

The Colleges

PROBABLY no single force in irrigation wields so mighty an influence in its advancement as the colleges and universities of the West. These institutions, by maintaining special divisions for the study of the subject, and encouraging research by both students and professoriat, have written a brilliant record of achievement. Irrigation as an industry has been singularly fortunate in the type of interest which it has stimulated from the colleges. In most cases this has been the direct antithesis of pedantic, academic curiosity. It has been, rather, the intelligent, far-visioned and practical efforts of men familiar with the irrigator and his problems to meet his needs in the most direct and unselfish way.

The work which the western schools are doing for the industry is many-sided. While it touches many abstruse and complex phases of the technology of irrigation, at the same time it is performing services easily understood and evaluated by the non-technical man. In a series of articles prepared by leading educators of institutions of higher education in Arizona, California, Oregon, Washington, Idaho, and probably other western states, MODERN IRRIGATION is presenting to its readers a series of sketches, of which the accompanying article is the first, giving an outline of what these services actually involve. Each of these articles, in addition to being an illuminating description of the work of the colleges for the industry, will contain information of direct practical interest to the reader.

The EDITORIAL

MODERN Irrigation

Reg. U. S. Pat. Off.
Published Once a Month
AT LOS ANGELES, CALIFORNIA, BY THE
PETROLEUM WORLD PUBLISHING CO. *Editorial and Executive Offices, 626 South Spring Street, Telephone Broadway 3262.* Branches: SAN FRANCISCO—447 SUTTER STREET, *Telephone Garfield 2772;* H. E. TAYLOR, *Manager.* CHICAGO—1163 MONADNOCK BLDG., *Telephone Wabash 8855;* JOSEPH E. O'CONNOR, *Manager.* NEW YORK,–56 W. 45TH STREET, ROOM 1105, *Telephone Vanderbilt 3672;* WERNER HAUPTLI, *Manager.*

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By Annual Subscription in the United States and possessions, $2.00; Foreign, $2.50; Single copies on sale in the irrigation country, 20 cents. In ordering change of address, give both the old and the new address. Allow ten days for re-entries on the subscription list. Advertising rates and circulation data upon request. Checks should be made payable to Petroleum World Publishing Co.

Vol. II SEPTEMBER, 1926 No. 9

Dedicated to Waterworks

FORTY-FIVE years ago at St. Louis, Missouri, the American Water Works Association was born. The engineers of that day who constituted the last authority on waterworks matters were some of the first of the professional men in this country to discover that the association idea is not only desirable, but quite essential, from an industrial standpoint. Cemented by a community of interests the organization flourished, the membership growing from a handful in 1881 to over 2500 in 1926.

The California section of the association has come as a natural outgrowth of the big development that the west has seen in the last quarter of a century. The California section's growth has paralleled that development. Since 1920 the association's year of activity has, each season, been brought to a climax by the annual convention, this year's meeting being scheduled for October 28, 29 and 30 at San Diego. The 1926 convention, by all signs, is to be the greatest, in point of attendance and the general excellence of the program, of all those that have been held. This is to be expected, considering the continuing growth of the association.

THIS year MODERN IRRIGATION is happy to play a small part in making the California convention a success and, in fact, will dedicate to the convention its October issue, in which will appear the first publication of WESTERN WATERWORKS, the new waterworks journal of the west. This number of MODERN IRRIGATION, too, will be the first **annual waterworks number** and will, from the standpoint of editorial content and advertising appeal, be especially edited for the waterworks executive and engineer. No pains are being spared to make this number a real, practical compendium of information, boiled down to give important facts, without extraneous matter; a sort of annual handbook for the western waterworks industry. With the usual features of interest to irrigationists and water developers in general, the number promises to be the most noteworthy that the publishers have issued.

That many an advertiser sees, in this special number, an opportunity to reach all branches of the hydraulics field in one medium is apparent from the response of those who sell either to the waterworks field exclusively or to the combined hydraulic industries of the west. The idea of WESTERN WATERWORKS—a magazine within a magazine—has apparently scored a bull's eye in filling a need long felt by the engineer and the advertiser alike. The advantage of a coverage of all phases of hydraulics in the one publication, for one subscription and at no increase in advertising rates, has its appeal to both.

The special October number will reach all of the regular subscribers in the hydraulics field and it will also be distributed at the convention at San Diego. The issue will carry all the pre-convention news and will be read on the spot, for the practical information it contains, by those attending the convention. The November number will have as wide an appeal because of the full accounts it will contain of the various papers to be read and a report of the transactions of the convention.

The convention number is to be an annual feature of MODERN IRRIGATION. It will be the one time in the year when the publication as a whole will have a predominating waterworks flavor, although the fact must not be lost sight of that each monthly issue will carry its quota of waterworks features and news items. Each issue will continue to constitute a "magazine of applied hydraulics" in every sense of the word.

Political Straws

THAT OBSERVER would be foolish indeed who would try to draw conclusive inferences from the recent primary election in California in relation to irrigation affairs. Although there were a number of issues involved in the major contests directly affecting the irrigationist, they were, after all, not the dominating issues of the campaign, and the outcome, in which the present governor of California was defeated in the contest for the Republican nomination for that office, was so close that it is impossible to say that the electors pronounced their will definitely or distinctly on any question of irrigation involved.

POINT *Of* VIEW

It is worthy of some attention, however, that Governor Richardson, the defeated candidate, was bitterly attacked by his opponents on the basis of his irrigation record, and in sections where irrigation is the life-blood of the country, notably in some sections of the San Joaquin Valley, the observer may easily read into the large majority accorded the governor's opponent a reflection of some dissatisfaction with the record of the present administration.

Another indictment brought against Governor Richardson was an accusation of costly economy in the matter of provision for forest protection. It is no secret that the champions of forest conservation have been far from happy at what they considered the insufficient state appropriations approved by the governor for forest protective work. Lieutenant-Governor Young, the governor's opponent, in his successful campaign for nomination, stressed the unwisdom and niggardliness of the administration's forest policy, and made definite promises of a more generous provision for this phase of the state's activities, if elected. If he becomes governor, as he will in all human probability, the advocates of reforestation and conservation will have a declared friend at the capitol.

Words, Idle Words

DIRECTORS of the Oakdale and South San Joaquin irrigation districts, in central California, ran across a problem the other day which stumped them more completely than many much weightier aspects of the great two-million-dollar job on which they are now engaged—the Melones dam. It seems that the dam, when finished, is to bear a nice bronze tablet, with an appropriate inscription. The representatives of the two directorates agreed upon a legend which seemed to fill the bill, and when they asked for an estimate of what the tablet would cost, they were surprised to find that the price would run around $250.

"Too much," said the conscientious directors. "The tax-payers of our districts don't mind paying what is necessary for irrigation water, but they won't stand a per-acre assessment for words. Let's see if we can't reduce the number of words on this tablet and thus cut down the cost."

But that wasn't so easy. The imperishable bronze is to bear the names of ten directors, the officials of the two districts, and the name of the company which is building the dam, and these things don't easily permit of abridgment or condensation.

Better pay the cost of the tablet, gentlemen, and have it in the form originally contemplated. The glory that a director of an irrigation district gets out of his job is brief and meagre enough. The Melones dam will continue to benefit the districts which it serves for many a year after that $250 is completely forgotten, and it will be a salutary thing for future generations to see, carved in the bronze tablets, the names of the men who gave their time and thought to its construction when it was only a vision, and who brought that vision into material reality.

Mexico and Irrigation

MEXICO is a land of contradictions in relation to irrigation, as to so many other things. In point of time, it is the cradle of irrigation on our continent, and, in the practice of irrigated agriculture, there are doubtless secrets that it might impart to its more advanced neighbors to the north. As an article elsewhere in this issue points out, however, it remains largely a country of undeveloped potentialities.

Depending to a large extent on irrigation for the successful practice of agriculture, it has, nevertheless, failed signally in those collective aspects of irrigation development in which the western United States has made its greatest record of achievement.

Whether the Calles government can work out a practicable reclamation policy under the terms of the law which is described by R. A. Hill, in this issue, is a question which can be answered only by Time. If the law is administered in the interest of the people for whom it has been ostensibly framed, in the light of the experiences of other governments which have learned costly lessons in large-scale attempts at reclamation and settlement, it may provide a basis for a workable system. If the Mexican government will be wise enough to draw upon the knowledge of the eminent engineers and reclamationists of the United States, as well as the best informed of their own countrymen, there may be hope for better things for irrigation in Mexico. If, however, a selfish policy of personal aggrandizement is to actuate those who administer the law, its failure will be inevitable no matter how sound its theoretical basis.

Just now, with a religious controversy raging in Mexico, the eyes of millions of people are turned in the direction of that little understood country. What the outcome of the present crisis may be, it is impossible to predict, but one effect, at least, may be to increase the popular interest in its economic, as well as its social possibilities. Irrigationists will find here a peculiarly fascinating subject. Many of the notable irrigation developments of the next fifty years will take place south of the Rio Grande.

Here is what irrigation has done to the desert in Nevada. Some conception of the growth of the crop may be obtained by comparing it to the figure in the foreground.

What Irrigation Has Done for My State--NEVADA

By JAMES GRAVES SCRUGHAM
Governor of Nevada

THE irrigated area in Nevada is about 560,000 acres. This is as compared with about 3,000,000 acres of lands in private ownership in this state. Of the 110,000 square miles in Nevada's boundaries *eight-ninths* is public domain, owned and in the keeping of all the people of the United States. In consequence, Nevada is largely dependent upon the care and control of the federal Department of the Interior, which supervises the public domain, including the lands useful for mining and, in part, grazing. The Department of Agriculture also controls in a measure the destiny of Nevada.

Federal reclamation and irrigation has been one of the most ambitious, constructive and beneficial enterprises of government ever carried out in the history of the nation. The era of interstate canals, interstate post roads and highways and of federal development of rivers and harbors, was a translation of the powers of the Constitution affecting interstate commerce and the promotion of the "general welfare." It was in pursuit of the latter principle as well as in discharge of its duty as conservator of the public domain, that the nation embarked on the project of reclaiming the arid lands that constituted a vast empire in the West.

Nevada had a distinguished share in the origin and history of this movement, for it was Senator Francis G. Newlands, now deceased, who gave the greatest impetus to the work. It was he who secured the appropriation of more than $90,000,000 as a revolving fund for the construction of irrigation projects, with the idea that the units would take care of themselves and finally return the invested capital so that it could roll on to other fields of construction. About 2,000,000 acres of new lands have been irrigated. A new farm population of about 142,000 has been created with 37,000 irrigated towns and the creation of about $600,000,000 new national wealth. Crops worth more than $100,000,000 annually are produced and about $200,000,000 has been expended in construction, of which about $60,000,000 has been repaid and replaced in the fund. The incidental prosperity and commerce arising from this production has been enormous.

Nevada has had her share of this development. The Truckee-Carson (now the Newlands) project, was the pioneer experiment in irrigation under national auspices. Naturally the government learned by the experiment in an engineering, social and financial way and, naturally, the settlers who first came to Nevada had the hard row to hoe. In consequence the Congress has recently charged off and relieved the settlers from a burden of about $5,000,000 of debt originally included in the construction and carrying charges. The waters supplied also fell short of those anticipated and the $7,000,000 originally expended was increased by $2,000,000 more for an added reservoir. The actually farmed area proved much less than that outlined in the beginning as feasible.

Irrigated lands in Nevada include:

	Acres
Humboldt river basin	198,000
Truckee river basin	20,000
Carson river basin	71,000
Walker river basin	113,000
Central interior basin	66,700
Colorado river basin	8,500
Snake river basin	83,800

These districts not only use most of the surface run-off but have use of reservoirs impounding an aggregate of about 500,000 acre-feet of water.

In 1904 the area that would be reclaimed in the Truckee-Carson project was estimated at 210,000 acres. At present the actual irrigable area is 73,302 acres and the ultimate irrigable area is 97,400 acres. At present only 61 per cent of the irrigable land on the project is farmed. The crop value in 1924 was $1,405,120. or $34.47 per acre. There were 762 irrigated farms and a population of 2,668 including 5 towns with a population of 2,300, 11 school districts, 9 churches, one bank with 1,700 depositors, 25 new settlers coming in and 10 old settlers going out.

It will be seen that irrigation under government auspices has not been a striking social phenomenon in Nevada, but the outlook is hopeful. Congress has authorized an additional project, the Spanish Springs unit of the Newlands project, and plans are making for a project in Carson Valley and on the Humboldt River. The figures here, while intrinsically small, are large in proportion to the state's life. The total products of the livestock and agricultural industry on the one hand and the mining industry on the other are less than $30,000,000 annually. The projects anchor people in communities, and in addition to the raising of alfalfa, potatoes and other crops such as sugar beets, there is a nucleus of a valuable dairy industry.

J. H. Cox is New President of Irrigation Equipment Group

Zimansky Closes Successful Year With Annual Meeting at Sacramento

A MODERN IRRIGATION STAFF REPORT

JOSEPH H. COX will guide the destinies of the Western Irrigation Equipment Association during the year that lies just ahead, as the result of the election held at the annual meeting, in the Sacramento, Cal., Fair Grounds, on September 8.

On the "Cox for President" ticket, as submitted by the executive committee and unanimously passed by the members present, there were included the names of J. E. Lundy, vice-president; C. A. Utley, secretary, and J. J. Merritt, treasurer. The three other members of the executive committee will be R. R. Van Ness, D. Stevenson and W. R. Mongerson.

Retiring president Zimansky opened the meeting with some twenty-five members present. Various communications were read by secretary Utley, and the report of the treasurer was heard and approved.

Last of the Pump Tent

J. J. Merritt and Professor Fletcher announced there is every reason to hope that, by the time the 1927 California State Fair is opened, the pump exhibits will be housed in a permanent building instead of the old familiar pump tent.

R. R. Van Ness, who has labored industriously on the problems of smoothing out the well drillers' difficulties with the California State Motor Vehicle Act, reported that he had had several conferences with representatives of the general contractors, machinery and equipment dealers, and highway development associations. It has developed that the same rules of the state highway officials that bid fair to work a hardship on the well drillers are causing considerable concern to members of the other organizations named. Mr. Van Ness will continue as chairman of the committee with the likelihood that all of the agencies interested will cooperate with the W.I.E.A. in presenting an amendment to the Motor Vehicle Act for the consideration of the next legislature.

Professor Moses advised the meeting that the uniform contract for pump installations has finally been completed and will soon be presented for adoption to the agencies interested, namely, the Western Irrigation Equipment Association, the Pacific Hydraulic Engineering Association, the California Committee on the Relation of Electricity to Agriculture, and the Federated Farm Bureaus.

Cost Details Worked Out

The final wrinkle to be ironed out, so that the plan will be fair to both buyer and seller of pumping equipment, was in the matter of the details and costs of the tests. As the arrangement now stands two tests will be available, the buyer having the option of taking one or both or neither. A prospective purchaser of a pump may have a manufacturer's test made before he purchases, paying for it at the rate of $1 per rated H. P., the minimum charge being $20. After the installation, and within a certain stated period, the purchaser may have another test made. If this test discloses that the pump is performing according to the maker's rating, the cost of the test will be borne by the purchaser; but if it develops that the pump is not delivering the flow in the warranty, the cost will be borne by the seller.

C. B. Noyes, who serves as chairman on the publicity committee, submitted a suggestion for a new W. I. E. A. membership seal and official "trade mark" of the organization. Mr. Noyes urged that some sort of device be adopted at an early date, that all members be requested to use it in all advertising and on their stationery. A call has been issued for ideas as to the proper design, these to be submitted to Secretary Utley, who will in turn hand them over to the publicity committee.

Zimansky Relinquishes Gavel

President Zimansky reported that the pump data book has been completely revised, and will be handed to the printer as soon as the members of the association send in their proper addresses and the names of the present officers of their respective companies. It was decided at a previous meeting to incorporate this information in the new data book.

In his retiring address Mr. Zimansky summed up the work of the association after five years of organization. Dealing with equal frankness in discussing shortcomings as well as accomplishments, he sketched the future possibilities of organized effort in the light of past accomplishments, bespeaking for the incoming officers the tireless and loyal support of the membership.

JOSEPH H. COX

The date of the next meeting was set for November 19 at San Jose.

Auburn Has Model System

Auburn, Washington, claims one of the finest water systems for a city of five thousand people that can be found anywhere on the Pacific Coast. This summer the Auburn people celebrated the completion of the new water project for which they had voted $200,000 bonds. The water comes from the Coal creek springs, about four miles away by pipe, near the White river on the east side of the valley.

Equipment has been installed for piping approximately 8,000,000 gallons a day. A dam which has formed a large impounding basin has been thrown across the stream and the water is diverted into a large 24-inch wood stave pipe line. About three-fourths of the water is used to operate the three Hill hydraulic rams. The reservoir is of 3,000,000 gallon capacity and is approximately 200 feet higher in elevation than the city. An adequate system of pipe lines for present needs has been laid and valves, crosses and tees have been installed so that additional lines may be laid to other sections of the city as the demand for water in these districts requires.

Another important product of the irrigated farm. Part of a prize herd on the Delhi (California) settlement.

The Farm Tenancy Question

(*Continued from Page 15*)

farms would be operated by tenants. Moreover, the young man would have the guidance of the landlord father in steadying him during his apprenticeship.

Actually, we have other conditions entering in, some of which have been mentioned above. In the country as a whole, tenancy is undoubtedly to a large extent a stepping stone to ownership. Whether this is generally true in the irrigated west, it is hard to say. Observation leads one to think that in many cases it is, although a recent study indicates that no such condition exists in California. The study referred to is that made by a committee of the Commonwealth Club of California under the chairmanship of Professor R. L. Adams, of the University of California.*

Two criticisms that have been levelled at tenancy here and elsewhere are that the tenant is likely to abuse the farm and that the absentee landlord may not adequately equip it. Two suggested remedies may be mentioned. One is that a long lease be employed so that the tenant may safely make improvements without fear of having the rent raised. A second suggestion is that the tenant be protected against an unscrupulous landlord by some such arrangement as is in use in England.

It might be pointed out that the long lease alone will hardly solve the problem. In any new country—and that applies to all our western states—particularly where conditions are rapidly changing, few tenants care to bind themselves with long leases. Even in an older country this has not always proved satisfactory. In England, at the beginning of the last century, long leases prevailed, but the fluctuations in price resulting from the Napoleonic wars brought them into disfavor with both landlords and tenants, so that by 1850 short leases again came to prevail. Since that time an elaborate scheme has been developed for protecting the tenant.

Under the English Agricultural Holdings Act of 1923, improvements are divided into three main groups and different rules are applied to each. The three groups and the rules applying to each are briefly as follows:

Group I, in which written consent of the landlord is required if the tenant is to obtain reimbursement for unexhausted improvements upon leaving. This includes such permanent improvements as the erection or alteration of buildings, the erection of silos, the laying down of permanent pastures, the making of improvements on roads or bridges, the making or removal of permanent fences, the reclaiming of waste lands, and similar activities.

Group II, in which notice to the landlord is required, but consent is not necessary, includes only drainage.

Group III, in which neither notice to nor consent of the landlord is required, includes the liming of land, application to the land of purchased manure or fertilizer, benefits to the land from the feeding thereon of cattle, sheep, pigs or of horses other than those used regularly on the farm, the laying down of temporary pastures, and necessary repairs other than those the tenant is under obligations to make, etc.

An elaborate system of evaluation has been developed and a large corps of appraisers has been trained in order to facilitate the frequent settlement of disputes on a scientific basis as farmers move from one holding to another.

Whether such a scheme is feasible or desirable in the United States may be a matter for debate. We do, however, need a clearer recognition of the facts that (1) tenancy is undoubtedly here to stay, and (2) our laws and our practices should be such as will develop our tenancy system so that it will permit such utilization of land as may be demanded by national welfare, whether considered from the economic or the social viewpoint.

*(See Transactions of the Commonwealth Club of California 17: 399-448. November 1922, and California Experiment Station Circular 272: 2-48. November 1923).

Irrigation Practice in Mexico

(*Continued from Page 13*)

Mexico have been the result of the peculiarities of climate and of the character of the works which have been constructed. Practically no rivers of Mexico are supplied from melting snow, consequently they are subject to wide fluctuations, coincident with the occurrence of rain.

The irrigation systems have in general been built by individuals for the irrigation of their own land holdings. There are few cases of large distribution systems serving groups of owners and almost no examples of storage regulation for irrigation.

Employ Bolsa Method

The common system of irrigation, therefore, has been by the *bolsa* method, similar to the system of flooding much used in California in the latter part of the 19th century, and still practiced to some extent. High borders are built around each field, water is admitted into the basins thus formed, and allowed to stand until absorbed by the soil or evaporated. Frequently only a single irrigation is possible, although this may be more than two feet in depth.

Until the streams are regulated by the construction of reservoirs this method of irrigation will undoubtedly remain customary, except along the east coast where the flow of the rivers is more uniform.

There are some projects, however, which are being developed along modern lines, particularly those where only a small portion of the ultimate area is now irrigated. On the Yaqui River, for example, approximately 100,000 acres are being irrigated in accordance with the most modern practice by direct diversion from the river. Further expansion of this project, however, is entirely dependent upon stream regulation. The same condition prevails along the Fuerte river in the vicinity of Los Mochis.

Success Lies in Future

The success of modern irrigation in Mexico cannot be determined for many years. Undoubtedly some projects will be constructed which will not be found worthy and the cost of development will in many cases greatly exceed the amount now considered as necessary.

There is little accurate data available as to the amount of water which can be supplied to the lands in the various river valleys. As irrigation has heretofore been almost entirely from unregulated streams, and as few works of great magnitude have been constructed, there is little experience to guide investigators in their determination of the needs of any region, and of the cost of development to supply those needs.

The agricultural products from new irrigation projects will be absorbed to a large degree by the people of Mexico itself. Surprising as it may seem, Mexico is a food importing country, although its population is only about 15,000,000 and its area 760,000 square miles. This situation is due, not to lack of productivity, but largely to transportation limitations. A large percentage of the people live on the Mesa Central, which agriculturally is of secondary importance. The productive agricultural regions along the coast are in a large measure isolated from the interior. Improved transportation, therefore, will provide in a large measure the market for the agricultural products of these new projects.

The future of irrigation development in Mexico is fundamentally dependent upon the degree and effectiveness of colonization. The Mexican Indians who comprise the bulk of the population, are not by nature farmers in a modern sense of the word. It is expected that much of this land will be developed by selected immigrants from those European countries which are fundamentally agricultural.

The most striking phase in the irrigation development of Mexico is the avowed intention of the Government, as testified by its chief executive, that this development shall be sanely and economically carried out, and that everything shall be on the basis of "pay as you go."

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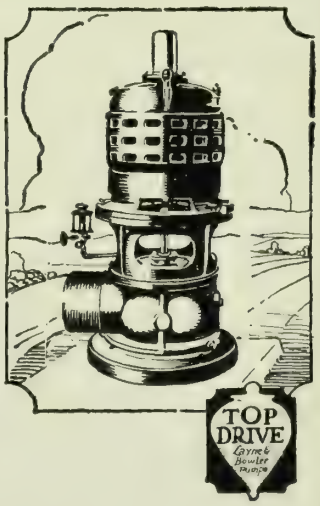

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THE HYDRAULIC DIGEST

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Tacoma Plans New Reservoir

Tacoma, Washington, has awarded the contract for constructing a 25,000,000-gallon reservoir for the city water department. Construction is to be completed by April 1, 1927, so that relief may be given next summer.

Irrigated Farms Total 35,000

There were on June 30 a total of 35,000 irrigated farms in the United States, with a total population of 137,000, or an average of a little less than four persons to a farm, according to figures recently compiled by the Bureau of Reclamation.

Phoenix Extends Water System

Phoenix, Arizona, has awarded the contract for the installation of and material for the extension of the city's water system to Fisher & McCall. The sewer lines will be laid by Schmidt and Hitchcock, of Phoenix, with material furnished by the Arizona Concrete Pipe Co. The gross cost will approximate $360,000, secured by recent bond issue.

Water System Adds New Well

The Spring Hill Water Company, of Bothell, Washington, has recently drilled a new well to add to the city water supply. On a four-hour test it furnished over 5,000 gallons an hour, an amount greater than is considered necessary for the city's needs. There has been a critical shortage of water in Bothell this summer and the company has made every effort to prevent similar trouble in the future.

Fixes Spraying Charge

The city council of Long Beach, California, has adopted a new policy in regard to sale of city water to ranchers for spraying. City Engineer Fred C. Froehde pointed out that, under the arrangement that has been in force, the ranchers were ruining the fire hydrants by using Stillson wrenches on them. After lengthy discussion the council voted to make a charge of 50 cents per acre sprayed inside the city and $1.00 per acre outside the city. This rate is to go into effect Oct. 1, when the city takes over the properties and rights of the Consolidated Water Company.

Laguna System Ready Soon

Steps for the completion of the $600,000 water system being installed at Laguna Beach, California, were taken when the water board recently called for bids on the main line to be laid from the Santa Ana River basin to Laguna Beach, a distance of about fourteen miles. The work, according to the engineer's estimates, will cost about $240,000. More than $380,000 has already been spent in the district in piping water to the houses and in laying mains throughout the city.

Organize Water Company

The Port Costa Water Corporation, announcing headquarters as San Francisco, recently filed papers with the Secretary of State. The corporation, which announced plans to construct water works, pumping plants, reservoirs, and other appurtenances to the water supply business, was organized by Allen L. Chickering of Piedmont, H. T. Beverly of Oakland, and A. Demartini, D. M. Gregory, Vincent I. Campagno, W. C. Fox, and A. E. Porter, all of San Francisco.

Dry Season Teaches Lesson

The board of directors of the Central Oregon Irrigation District has been investigating the cost of securing the storage of Crane Prairie. The North Canal Company offered to sell all of its rights to this storage, the diversion dam and all of its property for $50,000, but the board considered the price too high and turned down the proposition. Several speakers at the meeting voiced the opinion that a season such as this was a valuable lesson to irrigators, teaching them to take care of the water they received.

Water Bonds Get Big Majority

By an overwhelming vote the residents of Brentwood, California, have established the first Contra Costa County water district to serve the town with a domestic water supply. One hundred and one out of 107 total votes cast were in favor of a $20,000 bond issue to purchase existing equipment, install complete fire protection, and develop new wells for local supply. This step will assure the immediate construction of a number of houses which have been delayed for lack of adequate water supply and fire protection.

Snohomish Wants More Water

Snohomish, Washington, has suffered such extreme water shortage this summer that the city council has taken steps toward increasing the capacity of the pipe lines. A firm of Seattle hydraulic engineers recommended to the council the installation of four miles of 20-inch pipe from Gemmer hill to the dam, which impounds the city's water supply, and the construction of a new dam, or the installation of a pump at the present intake to increase the flow. It is estimated that the dam would increase the flow 500,000 gallons a day, and the pump 300,000. The cost of the dam has been estimated at $17,600, the pump at $6,000, and the pipe line $76,000. Councilman Bakeman, head of the water committee, stated that the demand was almost double the supply. He has urged the installation of meters, but that plan has not met with favor.

Rockwood Wants Water Now

Whether to dig wells or suffer a long thirst until next spring is a question that will have to be decided by the Rockwood water district (Oregon). A committee was recently sent to confer with John M. Mann, commissioner of public utilities, on the prospects of getting Bull Run water immediately. Commissioner Mann told the delegation that as soon as the Bear Creek dam is completed there will be plenty of water, and the district can have all it wants. If there is a hard winter and plenty of snow, Rockwood will be able to get the connection in the spring. "The people voted $72,000 to lay mains and make the connections with Bull Run water," said the delegation, "and they want the water now. We must have water or the people will not stay there." They declared their readiness to install a 200,000-gallon tank to hold a three-day supply, and to meet every city regulation.

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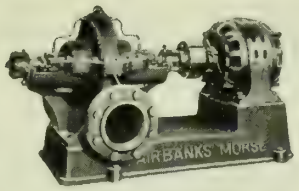
By way of expressing their conviction that the states' needs are the needs of the San Joaquin Valley, the directors of the Lindsay, California, Chamber of Commerce recently took out a blanket membership for their 300 members in the California State Irrigation Association. The action of the Chamber of Commerce follows that of the Lindsay Farm Center, which recently took out a blanket membership for its 240 members. The chamber also appointed a committee to work with H. E. Martin, of Tulare, campaign manager of the association, in a canvass of business organizations in the community to get them to take similar action. Mr. Martin says that the association is squarely behind the plan of the state engineering department to bring the flood waters of the Sacramento river into the San Joaquin Valley for irrigation purposes. The state engineering department, under the leadership of Paul Bailey, has been working on the plan for some time and has indicated that it has been found feasible from an engineering standpoint and that the cost would not be excessive. Mr. Martin states that if the valley can present a united front the plan will receive favorable consideration in the next legislature and the water problems of the valley will be solved.

Will Vote on Water Bonds

Chowchilla, Madera County, California, is to vote this month on the proposed $25,000 bond issue for the purchase and improvement of the local domestic water system. Under the plan to be submitted to the voters, either the old system will be purchased and repaired, or an entirely new system installed. According to B. O. Weber, city engineer, the present system can be purchased for $17,500, and improvements which would care for the city's needs for the next 25 years could be made for the remainder of the $25,000. Replacement of the present system would cost about $30,000. The present system was installed in 1912 and includes 20,000 feet of lines.

Plans Big Reservoir

Forecasting immediate construction of a storage reservoir in the Deschutes Basin (Oregon) which will be one of the largest in the state, the Arnold Ditch Company has filed on the entire run-off for storage of the Big Marsh watershed. Big Marsh is a depression similar to Odell and Crescent lakes. A dam thrown across the outlet, or at some point in Big Marsh creek below the outlet, will convert this marsh into a big lake, holding the winter run-off from the high Cascade country. The available storage is 38,000 feet.



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MANAGEMENT

Lateral Maintenance---Always a Tough Management Problem---Is Well Handled Here

By FRANK FYFE,
*President Sunnyside Irrigation District**

FROM the very beginning of reclamation work, the problem of maintenance of laterals has continually impressed itself upon the organizations in charge. Unfortunately, a great many people harbored the erroneous idea, that when the construction was completed, the next step would be to turn in the water, and it would be at their service for all time without further cost or effort. The fallacy of this idea was forcibly impressed when it was found that new laterals were subject to breaks during the first few years of their use. The banks being amply supplied with water, furnished an ideal place for a profuse growth of grass, weeds, etc., which fell over into the laterals, and not only greatly retarded the flow of water, but impregnated the surrounding lands with a surplus of moisture, causing them to become alkalied or water logged, and in many instances the lands became valueless.

It soon became apparent to the organizations delivering water, that the time would come when the cost of operating and maintaining of laterals would be in excess of their original estimate.

Later, the United States Reclamation Service took over the works of the Sunnyside Division of the Yakima Project, and assumed all of the obligations necessary for the operating and maintaining of the system down to 10 c. f. s.

Cumbersome Arrangement

After the Government had assumed control of the Yakima Project, it soon became apparent that direct dealings between the Government and individual water users were too cumbersome. It necessitated too much detail work from the Washington Office with each individual water user. Consequently, water users' associations and irrigation districts were formed to act as intermediaries.

*A paper read before the Thirteenth Annual Meeting, Washington Irrigation Institute, Yakima, Wash.

Back in 1922

When Frank Fyfe first became a director of the Sunnyside Valley Irrigation District in Washington the work of lateral maintenance was divided into 49 maintenance districts and carried on by the district crews and Reclamation Maintenance crews. The method was impractical and the cost too high—96 cents an acre. Mr. Fyfe suggested the unique idea of selecting a foreman in each district from among the water users in that district, who should call out the men of his district to care for the laterals, thus localizing the work and expense, and eliminating the cost of time and conveyance in going to and from work. The plan did not meet with much enthusiasm, but the directors finally agreed to give it a trial. And now, four years later, the success of the plan has been fully realized. There are now 74 maintenance districts instead of 49; and the average cost per acre last year was 48 cents as against 96 cents under the original plan. The plan itself, involving as it does many individuals of unlike character and disposition, would be doomed to failure if it were void of that one great principle so necessary to all organizations where interests are mutual—cooperation.

One of the purposes of the Irrigation District was to cooperate with both the Reclamation Service and the water users. The Reclamation Service operates and delivers the water to all farm units and does the maintenance work on all main and branch canals down to the ten second foot point. And from this point on the maintenance is left to the care of the water users to get along the best way they can. If the laterals are small, they can get along very well by just turning out and each doing his share of the work. But on the larger laterals it is very different. There are many non-resident owners that have renters on their farms, and most of them do not help with the cleaning of laterals or help with the expense of repairing the flumes or pipe lines. They, of course, feel their landlord should stand any expense of getting the water to the land. Then, there are always some of the land owners that are very busy at lateral cleaning time, and cannot get out to do their share, so it quite often falls on a few to get out and do the work.

Collection Method Devised

The officials of the Sunnyside Valley Irrigation District benefited by the experience of the Sunnyside Water Users' Association, realized that there would be an expense attached to the care of laterals, and that an insured method of collection was necessary. Accordingly, by-laws were passed authorizing a hearing on a petition for the formation of a maintenance district on any lateral when such petition is accompanied by signers holding at least twenty-five per cent of the acreage.

When the writer became director of the Sunnyside Valley Irrigation District in 1922, forty-nine of these districts had been formed, and the work had all been done by Sunnyside Valley Irrigation District crews and by Reclamation maintenance crews. This method was impracticable. The expense was too high, costing on an average of 96c per acre. The directors were besieged by the water users from all sides. Many urged disorganization of the districts. It was apparent that a change was necessary. Something had to be done. The writer, a new member of the Board, suggested a change whereby a foreman should be selected in each district from among the water users of that district, who should call out the men of that district to care for the laterals, thus localizing the work and expense and eliminating the cost of time and conveyance in going to and from the work. Like all new ventures, this was not graciously received at first. It was thought impossible to get foremen who could efficiently maintain the laterals. However, no good cause is ever won in a single day, and, after continued effort and insistence, it was decided to give the plan a trial.

The success of the plan as outlined has been fully realized and these forty-nine districts have grown until they now number seventy-four, and we have two petitions out for signatures at the present time. Out of the seventy-four thus formed only two disorganizations have been effected. From the forty-nine districts organized and operated under the original plan and comprising 24,369.17 acres, we have grown to the seventy-four districts under the present plan with a total of 31,810.84 acres. The average cost per acre under the present plan for last year was 48c, as against 96c per acre under the original plan.

What the Colleges Are Doing

(*Continued from Page 17*)

answer many of the questions of immediate concern to the irrigator.

Changes Taking Place

Within the past five years the general character of these investigations has undergone a decided change. In a comprehensive study of the economic use of irrigation water there are certain basic principles governing the use of water by plants and the movement of water through soils. In order to obtain more definite knowledge of these principles and laws, several of the colleges are making an intensive study of these basic principles. By growing deciduous trees and field crops in large tanks, insofar as possible under controlled conditions of soil moisture, the rate of extraction of moisture by the plant, the relation between rate of loss and the existing moisture content of the soil, and the point in moisture content at which the plants or trees wilt in the various soil types may be observed.

This work is extended into field plots, where, by means of intensive soil sampling, the results obtained from tanks may be verified or disproved, and in addition to this, determinations are made of the depth of moisture penetration resulting from varying depths of water and applied. Such tests include, also, observations of the rate of moisture loss following irrigation, the depths from which moisture is being taken from the soil, the effect of cultivation in moisture conservation and as an aid in absorption of irrigation water by the soil. The results obtained are correlated with crop yields, rate of growth, time of maturity of the crop, and so forth.

Commercial Tests Sought

Further extension of these intensive studies is being extensively made in commercial fields to determine the consumptive use of water—that is, the to-

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tal amount of water in acre-feet, including evaporation from the soil surface, being taken from the soil in the production of commercially grown crops. This work is carried on in carefully selected areas representative of standard practice in crop production and irrigation. The total quantities of water applied to the field as a whole and to the selected plots within the field are carefully measured. In the areas selected for intensive studies, a thorough sampling of the soil for moisture content is made before and after each irrigation, showing the available moisture in the soil at the time of irrigation; the depth of penetration and the distribution of the water applied; the efficiency of the irrigation in per cent of soil mass which actually has been moistened, the rate of extraction and depths from which water is taken from the soil and finally the total seasonal use of water by the plants.

The information thus obtained, when properly interpreted, should form a basis for more efficient irrigation practice, giving the irrigator definite data concerning the seasonal water requirement of the crop in question, as well as furnishing data concerning the desirable frequency of irrigation and depths of water to be applied at each irrigation on the various soil types.

Field Observations Vital

By means of field observations, various phases of methods of irrigation and preparation of land are being studied by a number of the agricultural colleges. It is recognized without question that the character of the crop grown, the extent of the water supply, the method of water delivery, the topography of the land, and the soil type are all factors which influence the proper method of land preparation and irrigation.

As the necessity for a more economical use of the irrigation supply becomes apparent, the irrigator is going to ask for additional information on the method by which the greatest efficiency may be obtained under a given set of field conditions. Such questions as the efficiency and adaptability of spray irrigation for orchard and truck crops, contour planting and terracing as an aid in efficient irrigation, furrow vs. flooding in orchard irrigation, desirable width and grades in border irrigation, are of growing importance.

The author has, within the past few months, heard the statement made by several citrus growers of Southern California that their most serious irrigation problem in the future will be the difficulty of obtaining a desirable penetration of irrigation water into the soil. Observations recently made in a mature citrus grove showed that in certain portions of the grove a moisture penetration of less than 3 inches below the bottom of the furrow was obtained as a result of an eight-hour application of water. The question the grower asks is: Can this condition be remedied through a change in the method of irrigation and could it have been avoided? If problems such as this are of increasing importance, the colleges of agriculture, with the information now at hand, plus that now being obtained through systematic investigations and observations, should be able to render valuable assistance to the irrigator.

The problem of waste of water on the farm, either in transportation or application, together with methods of preventing such loss, is one upon which much information is available. Manufacturers of irrigation equipment are meeting the demands of the water user for higher efficiencies and longer life in pumping machinery, improved quality in concrete pipe and other types of conduits, and improved design in water regulating equipment. As the value of irrigation water increases, the demand for standardization of the methods of water measurement under varying conditions of flow will increase. Several of the colleges have interested themselves in this phase of the work.

Answer Definite Need

The Colorado Experiment Station, in its co-operation with the Irrigation Investigations of the U. S. Department of Agriculture in the development of the Venturi flume for the measurement of water flowing in open channels, under sand and silt conditions, furnishes an excellent example of what is being done to meet the demand of the irrigator for a practical method of water measurement under unusual conditions. Other colleges have equipped or are equipping themselves with various types of hydraulic or field laboratories, principally for the testing of water measuring devices and for determining the efficiency of various types of irrigation equipment used on the farm.

It is hard to realize that in California alone there are being commercially grown under irrigation more than one hundred and fifty different crops at elevations ranging from below sea level in the Imperial Valley to 3000 feet above sea level in the interior mountain valleys, with soil types ranging from the coarse gravels of the old river channels to the heavy impervious clays adapted to rice production. With this wide range of crops, climatic conditions and soil types, each soil type demanding special consideration in its preparation, method, time and depth of irrigation, and each crop with its individual water requirement, it may easily be seen that no matter how efficiently the irrigation work of the colleges is organized, they can scarcely hope to meet fully the continuously growing demand for information on the many phases connected with the economic use of water in irrigation practice.

Feasible or Not—How to Decide

(*Continued from Page 11*)

irrigation agriculture *can* be made permanent.

Economic considerations such as location, marketing institutions, and transportation, vitally affect the earning power and cost of production. The cost of agricultural development is an important factor in irrigation economics. The cost of development and of production may be decreased by scientific agricultural methods.

The ability and experience of the individual farmer in irrigation agriculture is a very important factor in profitable cropping. Conditions should be made such as will attract the experienced irrigation farmer, and only where these are promising will he be induced to settle on raw land.

The interest charge of undeveloped land on a project is a serious handicap. We have been encouraged too much by financing agencies to develop large projects and have not been encouraged sufficiently in culling out severely, so that only the best land should be included for improvement. Every undeveloped acre adds a double burden on the developed acre. Lands that will not be improved and working in a few years after a project is financed are liable to come to the district for taxes and had better be eliminated in the beginning, so that a smaller project can be initiated at less cost. It is a fallacy and an illusion to increase the total acreage of a project by including poor land, particularly in an irrigation district where all must "hold the sack" together.

The plan of fixing water charges according to the probable producing power of the land has been recommended for ten years and fortunately it has been adopted by the Reclamation Bureau as a result of the recommendations of the Fact Finders Commission. This gives a better distribution of the fixed charges for reclamation according to ability to pay. Districts should have a revolving fund to level, seed and resell lands received through delinquent payments. Contracts providing that half the increase in value due to the coming

of irrigation from raw land sales should go to the district will provide such a fund. Too early bond maturity is a common source of difficulty.

Credit Facilities Important

It has been estimated on several proposed federal projects that something like $7,000 or $8,000 would be required to bring a farm unit from sagebrush into full production, provide implements, stock, shelter, fences, and to clear and fit the land for crops. Agricultural credit facilities will be a determining factor in the feasibility of numerous new projects. The settler should have capital or equipment amounting to half of the capital required to develop a farm unit, but better agencies and methods for financing, to meet the balance of the capital need, must be developed. Water gives added value to arid land only if the lands are fitted and farmed. Raw lands in private holdings should be disposed of in suitable farm units at a minimum price to actual settlers.

Water rights and land titles should be clear and the water supply sufficient to meet irrigation requirements for suitable crops and types of farming. A project permitting sufficient water for straight alfalfa growing would not be considered a good project from an economic standpoint. The erroneous opinion is prevalent among irrigators that their water charges are not affected by the amount of water they use.

Crop rotation or use of an inexpensive fertilizer may increase the returns per unit of water and land and have a beneficial effect on productive value of land and water.

A planned program of land settlement by the organized colonization method will hasten the rate of settlement and shorten the time required to bring farm units to a condition of profitable production. It is believed advisable to fit a part of each farm unit and seed to a perennial crop like alfalfa. New settlers should be encouraged to invest as far as possible in growing crops or "live stock" and hold his investment in "dead stock" or building equipment to the least necessity during the first years. The Durham Colony, in Northern California, established in 1917, included 6,000 acres. It was put on the market in 1918 and by September, 1922, all the farms had been sold, and practically all the land was in either crops or pastures within five years from time of purchase. For projects of 10,000 acres and more, census figures show 66 per cent improved when these projects are 20 years old. These demonstrations point the way for private enterprises, as well as possible federal reclamation activities.

Cost of applying the water in the field must be included in the cost of production to be met before a margin of profit can be realized. The annual cost of water to irrigators, as well as the crop value, will affect that margin of profit. The main factors determining the annual cost of water to irrigators in reclamation districts are: 1—The district tax, (including bond interest, bond principal; the general fund for rentals, improvement, power, operation, and maintenance, and general administration); 2—The duty of water; 3—The interest on the capital invested by the farmer in addition to that of the district.

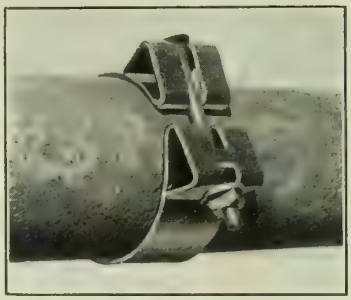
Good management of the project is important to keep the costs to a minimum. The annual cost of irrigation is increased for storing and delivering a larger quantity of water where a large amount is used per acre. Where this is used, it is especially costly on pumping projects, or where it causes alkali and drainage problems.

Other Factors to Study

Other factors affecting the economic value of land and water should be studied, including the existing indebtedness of a community and of its individuals, land ownership, and tax rate present and prospective. We should plan our reclamation program on a business basis and look ahead for a decade. We must look beyond the time when water is brought in and the land is sold off in farm units. We must consider the ability of the settler to meet his payments the third year, the fifth year, and every year, and until the project is brought into full production.

Immigration and increase in population may affect the economic feasibility of a project. National financial conditions and economic cycles will also have their effect. We should work for a national reclamation program that will ultimately utilize the water resources of the West and of the nation. The good land that can be added to the improved farm land by irrigation is no more than that of a single state, like Illinois, and this will all come to be needed, if this nation is to continue to produce its foodstuffs.

As a final illustration, I refer again to the soil. Soil may be uniform or it may have two or three layers or horizons in its profile. Likewise we may have one-, two-, or three-story men. The one-story man deals in facts, the two-story man plans and reasons with the facts, and there are some three-story men—men with a skylight, who, working in harmony with the great Architect of the universe, imagine, postulate, and create new concepts, and such men are needed to envision, create, and perfect the reclamation of our arid lands.



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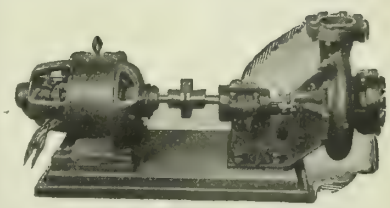

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WITH THE WATER COMPANIES

Of Interest Expressly to Water Works Engineers, Superintendents and General Managers

Marin County Job is "Crookedest" Pipe Line; Has Many Unusual Construction Features

By H. ELLIOTT TAYLOR

GET out all the old familiar comparisons that are used to express the superlative of crookedness—the corkscrew simile, the snake's-back metaphor, and all the rest—add a few original figures of speech from your own vocabulary, and you still will have done less than justice to that certain welded steel pipe line now under construction in Marin County, California, for the Marin Municipal Water District, of San Rafael.

And, in case Marin County is an unfamiliar port of call in your itinerary, it may be well to recall to your mind that that picturesque peninsula which forms one protecting arm between the Bay of San Francisco and the Pacific Ocean, extending down from northern California and almost meeting the San Francisco peninsula at the Golden Gate, is the seat of "Marvelous Marin"—so called by its loyal and patriotic residents, and not to be confused with the Marvelous Morons which are more common and not nearly so attractive upon long acquaintance.

The principal communities of this peninsula are San Rafael, San Anselmo, Fairfax, Ross, Kentfield, Larkspur, Corte Madera, Mill Valley, Belvedere, and Sausalito, and these are the towns, as well, that are served by the Marin Municipal Water District. Practically the entire southern end of the county will be benefited by the improvements now being undertaken by the district.

The crookedest pipe line, welded and ready for lowering into trench.

An Unusual Construction Job

The pipe line which is being built for this district is not only the ultimate in crookedness, however. It is, in many of its construction features, one of the most interesting examples ever afforded in the hydraulic industry of the possibilities of a welded steel line.

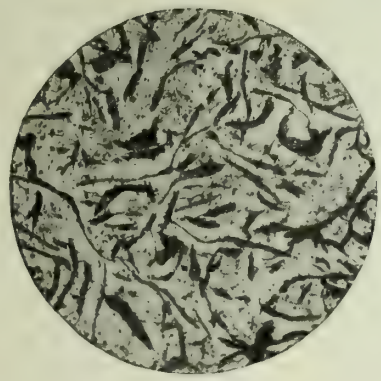
Formed in 1912, the Marin Municipal District represented a project the original cost of which was something more than $3,000,000. Several years were consumed in the necessary preliminaries of organization, including the voting of bonds, condemnation proceedings, and the purchase of the properties of the then existing water companies; and actual operation of the district as a distributor of water began in November, 1916.

Improvements since that date have added steadily to the value of the property and its usefulness to those it serves. The contract for the district's Alpine dam was let in June, 1917, and by January of the next year the structure was completed. In 1920 the district voted a second bond issue of $500,000 for improvements in the distributing system,

LEFT: Lowering a section of the welded line into the trench prepared to receive it, by means of the portable adjustable lowering device. RIGHT: The widest place in the entire bench—and no room to spare, at that. Note the winding course of the line as it skirts the mountain-side.

Micro-photo of

Sand Cast



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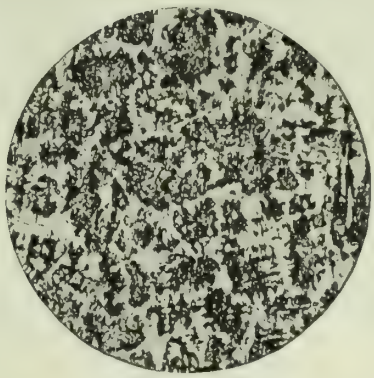

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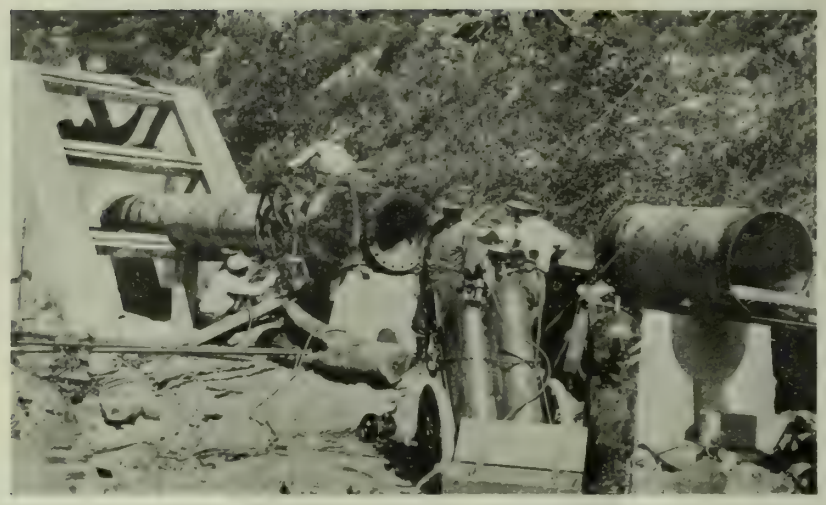

Where the new line ties in with the tunnel.

and in October, 1925, another and larger issue—this time for $1,500,000—was passed, to care for extensive improvements and enlargements made necessary by a constantly increasing demand for water. Under the terms of this issue, the steel transmission line is being laid.

The design of the Alpine dam (1917) is full gravity section, curved in plan, the radius of the upstream curve being 465 feet. The original height of the dam was 100 feet above stream bed, elevation 515 feet. The crest measures 325 feet, its thickness at the base is 78 feet, and the overflow is cared for by six siphon spillways.

In 1923 an addition to the dam raised it to its present height of 108 feet, which increased the storage capacity from 1,000,000,000 gallons to 1,500,000,000 gallons. At this time, also, sluice gates especially designed for the purpose were placed over the mouths of the spillways so that the water level can be maintained at any desired height between the crest of the spillway and the top of the dam. The normal rainfall over the 10,450 acres of watershed lands owned by the district is 56 inches annually. When the 6,000 additional acres now under condemnation proceedings have been acquired, and the necessary storage facilities have been provided, Marin County will have little reason to fear for a water shortage. A normal supply of about 35 million gallons per day will be provided when these plans are brought to fruition, while the present peak consumption of the district amounts only to 6.5 million gallons per day.

Big Work Going Forward

The new welded steel transmission line, is the theme of this article, and the foregoing is a digression—material, however, to understanding of the problems and status of the district. The new line is the first improvement to be undertaken under the most recent bond issue.

The original transmission line, from Alpine dam to the Phoenix gate house, the point of distribution to the various balancing reservoir, was of concrete. The ledge or road which was built for this concrete line in 1918 is being followed by the steel line now under construction.

The contractor for the steel work on this line is the Western Pipe and Steel Company. This organization is supplying 30,000 feet of 26-inch pipe and 7400 feet of 30-inch pipe, on which delivery was begun about the first of last June. The actual installation was begun about ten days later by Brown Brothers, of San Francisco, in a trench previously prepared by the district itself, with its own labor. To date, some 23,000 feet of pipe has been delivered to the trench. All of the pipe is of quarter-inch steel plate, with longitudinal seams electrically welded, and with all-round seams acetylene-welded. J. S. Peters, engineer for the Marin Municipal Water District, has the entire job as a whole under his general direction.

Unusual Difficulties Presented

The installation of the line necessarily presents a difficult problem. The topography of the country, and the character of the bench or road which is being followed, give at once the problem of excessive crookedness and the additional complication of a very narrow base for installation. Almost every one of the 14-foot sections of the line requires a mitre so that its continuity will conform to the line of the trench.

Before welding, the pipe is placed on collapsible wooden trestles set in the trenches. The trestles are all of the same height, about one foot higher than the depth of the trench, making it possible for the welder to stand in the trench and weld over head without necessitating the digging of bell holes.

Sections of the line 500 feet in length are welded in this way by each welding crew. The tie-in welders then weld two of these 500-foot sections together, and the first 500-foot section is lowered into the trench by special lowering devices. The natural spring of 150 feet of line is sufficient to allow for the difference in elevation between the section lowered into the trench and the portion remaining on the trestle.

By welding the pipe on trestles, it is possible to follow accurately the alignment of the winding trench. Despite the sinuous contour of the trench, which in some cases involves sharp angles, it has seldom been found necessary to resort to any digging of the wells of the trench.

Mechanical Obstacles Overcome

Brown Brothers have developed an ingenious device to facilitate the cutting of the ends of the sections in the required angles to secure perfect joints. This contrivance consists of an expanding spider set in the end of the section to be cut. The spider carries at its center a journal into which is set the shaft which carries the end of the cutting torch. The cutting torch is set at a definite angle at the end of this arm so that a beveled cut is made. The arm is adjustable in length so that any variation in the diameter of the pipe can be compensated.

The arm of the cutting torch is set to the required angle by means of a pro-

The bevelling machine, described in the accompanying article, as it appears in operation.

tractor attached to a shaft. The shaft and arm are rotated at any desired speed by means of a worm gear and crank, and thus the ends of the two sections are cut in an absolutely true plane, so that when they are placed together for welding they meet accurately and parallel, and insure a perfect joint. The time required to cut angles is thus materially reduced, and it is possible to make V-welds with a thorough sweat of the welding metal.

Weekly tests are made on shop welding, test specimens being cut from sections of pipe selected at random. At the present writing, thirty pieces have been pulled and only one piece broke in the weld—after developing a weld strength of 94 per cent. All other specimen pieces broke in the metal approximately four inches distant from the weld.

A number of bending tests have been made of the electric-welded joints, and no welds have broken. Four-inch test pieces were bent until the ends met, giving a bend of 180 degrees. From these tests it was concluded by the engineers that it is possible to produce in actual shop practice a one-hundred-per cent efficient electric-welded joint, using quarter-inch plate.

An imported Swedish steel welding rod has been selected, after severe tests of various kinds of rods, for use on this job. The acetylene gas is the product of the Commercial Acetylene Supply Company. The entire line is protected by a spiral wrapping applied after the pipe has been preheated and dipped.

Each User An Owner

The new water system of Earlimart, Tulare County, California, was dedicated on August 10. The Earlimart Mutual Water Company, composed of local business men, first began work on the system on June 10. Each water user is the owner of at least one share, of $100 par value, in the company. The system is composed of a 12-inch well with turbine pump and pressure tank. There are at present 2,093 feet of 4-inch mains.

Shafter Buys Water System

By a vote of 58 to 3, citizens of the Shafter Public Utilities District, Kern County, California, passed a bond issue of $24,000 for the purchase of the present water system and for its further improvement. Lines will be extended into the Lackenmair, Powell, and Potter subdivisions, and the present township will be enlarged. A new pump will be installed.

Seek Transfer of Mendota Company

A. J. Arnaudon has applied to the California Railroad Commission for permission to sell, and Mendota Mutual Water Company, to purchase the water system in the town of Mendota, Fresno County.

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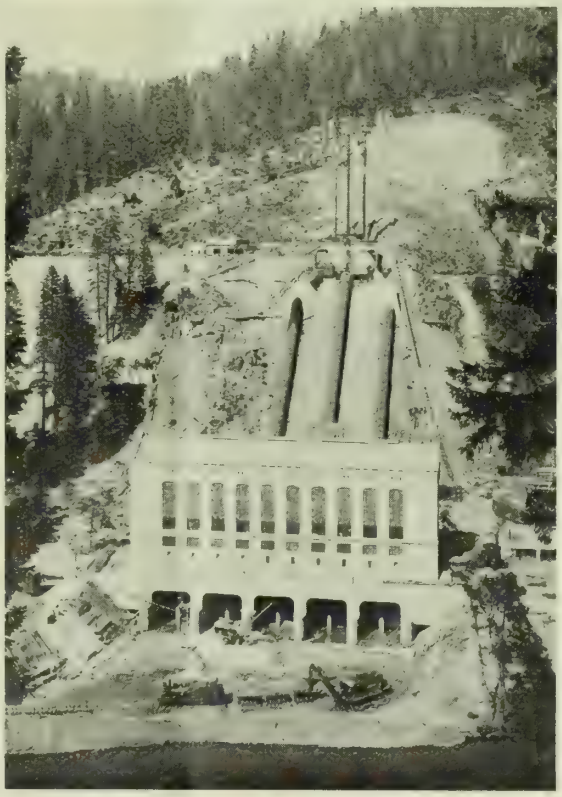

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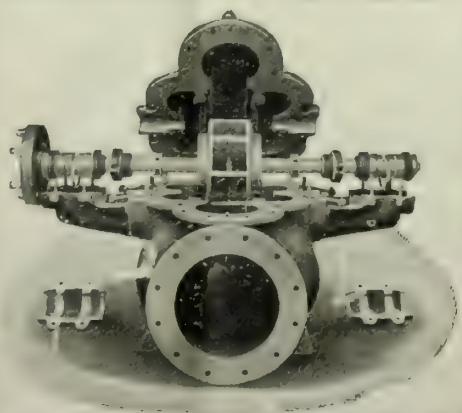

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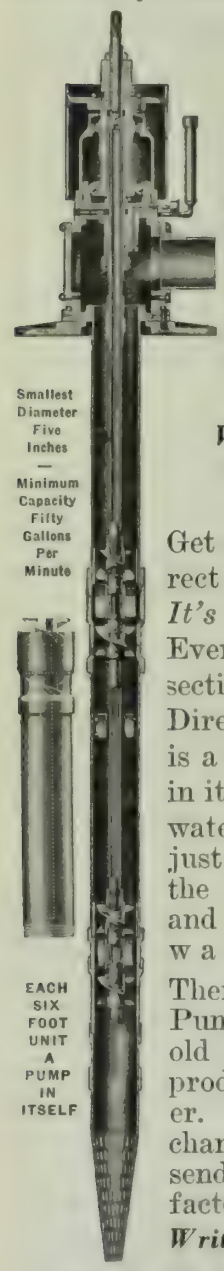

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Says Foes of Big Projects Fail to Grasp Time Element

Secretary Hoover delivered an address at a Los Angeles Chamber of Commerce luncheon early in September on the necessity of developing the country's water resources. The main point stressed throughout was the importance of such development being undertaken on a national scale.

"Water is the greatest undeveloped resource in America today," he declared. "There are 25,000 miles of inland waterways of which less than 6,000 is in use. There are also 30,000,000 acres of land that may be reclaimed by proper water development. The undeveloped resources now going to waste each year amount to billions of dollars."

The opposition to the extensive program he outlined is, Secretary Hoover thinks, largely on the part of agriculture and the railroads. Agriculture fears that the addition of large areas of land will create overproduction, while the railroads fear transportation competition, he said. "If it were possible to bring about this development in a few days, I would be opposed to it myself. But it must be remembered that these projects take time. Even if the program I have outlined could be started tomorrow, it would be at least fifteen years before it could affect agriculture. And it should be remembered also that ours is a growing population. Within the next ten years I believe we will see efforts being made to stimulate agricultural production to provide food for the public. As for the railroads, they have nothing to fear, in my judgment. Demands on transportation are increasing every year at a greater rate than facilities are provided for meeting them."

The Secretary enumerated a long list of controversial points that cause local friction and retard development, and said "These controversies settle nothing. Water development can be settled only by steam shovels and the pouring of cement."

In closing, Secretary Hoover stressed the point that no section should feel that it is interested only in one particular project. "It is necessary to adopt a view that embraces the water development program of the country as a whole. The country should unite in materializing the vision of developing its water resources."

Paving Affects Pipe Line

Los Angeles County Water Works, operating in the vicinity of Gardena and Moneta, Los Angeles County, California, has applied to the Railroad Commission for permission to abandon service from its pipe line located on the west side of Vermont avenue between Southern and Rosecranz avenues in case the county of Los Angeles begins grading Vermont avenue preparatory to paving the same.

Letter Gives Status of Overhead Irrigation in Hawaii

More than the usual interest attaches to the following letter just received by the Editor of this department from K. D. Bond, the agriculturist of the Hawi Mill and Plantation Company in the Hawaiian Islands. A detailed illustrated article describing their installation, the largest in the world, has been promised by Mr. Bond for a forthcoming issue of MODERN IRRIGATION.

"It is with considerable interest," writes Mr. Bond, "that I note the reintroduction of the department of Overhead Irrigation in MODERN IRRIGATION. In the development of overhead irrigation here in the Islands there is indeed a need for the authoritative, unbiased information which you now offer the readers of your paper. It is quite obvious that overhead irrigation would be in a far more satisfactory condition today had those who put in the first installations employed the services of an expert hydraulic engineer experienced in this line. Unfortunately we were not, until recently, aware of the work in California.

"The sugar plantations in the Hawaiian Islands," the letter continues, "are investigating the possibilities of overhead irrigation as applied to cane fields. Already Hawi Mill and Plantation Company has installed 636 acres, though others have been more cautious and as yet have only small, experimental areas. To date there are 764½ acres under this system, representing six plantations.

"The growth of overhead irrigation here has been similar in nature to the growth in California in that individuals here and there have from time to time experimented in a small way with overhead irrigation, often without knowing that anyone else was doing the same thing. The idea has gained ground very slowly and the present attitude seems to be that of watchful waiting for the results of present installations, especially the one here at Hawi.

"It must be acknowledged," the writer states, "that, from the irrigationist's point of view, overhead irrigation on this plantation is far from satisfactory. Those who are watching for harvesting results will unfortunately be given a wrong impression unless we can point out the mistakes in this Hawi system and suggest the remedies. Many of the mistakes are fortunately quite obvious. Others are more obscure and I welcome therefore, the opportunity to put some of these questions before competent authority.

"This is, perhaps, a crucial period in the history of overhead irrigation in Hawaii as many of the other plantations

harvest their experimental areas this year and all will be eager to know the outcome. For the most part the other plantations have adopted the Hawi system, sprinkler head and all. If the harvesting results of these various experimental areas confirm the results at Hawi the cause of overhead irrigation will receive a severe check.

"Fortunately," the letter concludes, "the areas involved are small and the yields are, I believe, better than we have obtained. But in any case it will be necessary to point out remedies and to show plainly where the trouble lies. Not the least thing to be done will be to acquaint the plantations with the types of sprinklers developed in the citrus country."

Cathedral City Gets New System

A certificate has been granted by the California Railroad Commission to Cathedral City Water Company, Riverside County, to operate a public utility water system in the sub-division known as Cathedral City, and to issue $10,000 of common capital stock in payment for the public utility water property. The Commission also established rates for such service based on a minimum of $1.25 per month for 400 cubic feet or less, and ranging from 25 cents per 100 cubic feet for the next 600 cubic feet, and 20 cents per 100 cubic for the next 4,000 cubic feet per month, to 15 cents per 100 cubic feet for all water in excess of 5,000 cubic feet per meter per month.

Will Issue $60,000 Bonds

The North Sacramento Light and Water Company has been authorized by the California Railroad Commission to issue and sell at not less than 95 per cent of face value, plus accrued interest, $60,000 of its first mortgage sinking fund 6½ per cent gold bonds, due July 1, 1946.

The water company will use the proceeds derived from the sale to pay outstanding obligations and indebtedness. The company this spring expended a large sum in improving its water system by the extension of water mains and the installation of a new pumping plant.

Allege Unjust Discrimination

The Inter-City Improvement Association, consisting of consumers of water served by A. B. Chapman Estate, a corporation, in the vicinity of San Gabriel, Los Angeles County, has filed a complaint with the California Railroad Commission against that corporation alleging that the rates and practices of that utility are unjust and discriminatory and ask the commission to fix rates, rules and regulations, affording complainants relief, and to award reparation to complainants if the same are found justified.

Seek Higher Rates

James M. and Florence V. Eva, operating a small water system for domestic purposes in Summer Home Park Tract, Sonoma County, California, have applied to the California Railroad Commission for authority to establish a flat rate of $18.00 per year for domestic service, and to establish meter rates, and for other relief, stating that their revenues are insufficient to maintain the system .

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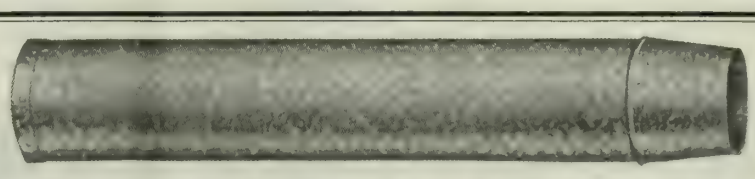

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TRADE NOTES *of the* MONTH

A DIESEL BUILT TO ORDER FOR THE EXCAVATOR

AFTER five years of close observation of small Diesel engines, and after considerable study and experimentation, the Northwest Engineering Company has built the Northwest-Cummins engine, a 4-cylinder full Diesel unit that is especially designed for use on excavating and material handling equipment. It is not, the company states, merely a marine engine placed on a shovel, crane or dragline.

The Northwest-Cummins brings the high efficiency of the true Diesel cycle minus the objectionable features of the ordinary true Diesel or the solid injection type.

In the well-known true Diesel cycle, which has been successfully and widely used over more than two decades in large size engines, the fuel is injected into the combustion chamber with a jet of high pressure air. This serves to break up the fuel very finely thus making it more readily and completely combustible. With this method it was naturally very difficult to secure effective operation in small cylinder sizes. First, a high pressure air compressor—an expensive and troublesome affair—was necessary, and second, accurate metering was impossible inasmuch as the metering had to be carried out by a variable stroke plunger pump or equivalent means.

In recognition of the troubles of the air compressor, engineers had been working for years on a solid injection engine that would permit of complete combustion.

Those who devised the Northwest-Cummins method of injection say it is the solution of the fuel metering problem. It brings the effectiveness of the air injection type minus the handicap of the air compressor and is without the high pressure pump and attendant difficulties of the solid injection type.

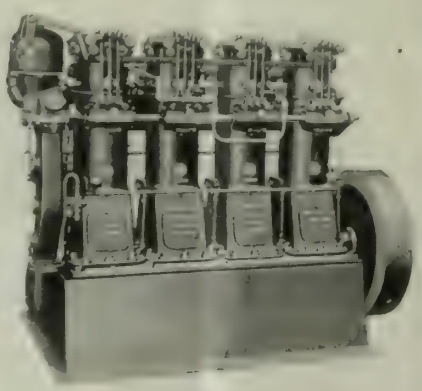
The solution of the metering problem is based on the fact that the fuel pump used on the Northwest-Cummins operates at only 50 pounds pressure. It serves only to keep the fuel at a constant pressure. This permits the use of simple needle valves for fuel metering. The four fuel injectors are fed by a common supply pipe.

A Diesel Dragline Owned by Paris Bros., Berkeley, Calif., and doing work at Rio Vista for the California Packing Co.

Because of more perfect atomization and complete combustion at all loads combined with high compression, the Northwest-Cummins burns a wider range of fuel, thus effecting the maximum in fuel economy. Everything on the engine that ever calls for adjustment or examination is readily accessible and most of those are in separate units easily dismantled or replaced. The cylinders are cast separately. This permits the easy removal of any cylinder.

The Northwest-Cummins is started by compressed air and gives a practically instantaneous start from stone cold. No heating by torch, hot bulb, cartridge or similar device is necessary and there are no electrical devices on the engine.

For starting, a small air compressor driven by a small gasoline engine is provided. This charges a large storage tank. Twenty minutes operation will suffice to fill this tank, and one charge of the tank permits from 10 to 15 starts. Cold or wet weather will not affect the starting of the Northwest-Cummins. It starts under all conditions even easier than a gasoline engine. A fuel tank of 100 gallons capacity is provided. Under the great majority of conditions it is unnecessary to take on fuel oftener than twice a week—a feature worth considering where fuel must be hauled long distances.



This 4-cylinder full Diesel unit was especially designed for use on excavating and material handling equipment.

Death Takes Parsons President

W. C. Bergman, president of the Parsons Company of Newton, Iowa, recently passed away at the age of seventy-one. Mr. Bergman was one of the pioneers in his line. In addition to his interests in the Parsons Company, he was president of the First National Bank of Newton.

Frank J. Kimball Expands

From a little office where engineering service and co-operation with pump users and owners were the keystone of the business, to a modern, two-acre production plant, all in twenty years, is the record of the Frank J. Kimball Company, Los Angeles, California, manufacturers of Kimball direct flow turbine pumps.

For the past ten years the Kimball Company has been located at 1860 East Fifteenth Street, Los Angeles, but the increasing business has compelled their moving to larger quarters. They have sold their present plant to the Liberty Foundry Company, and have bought nearly four acres in the Compton industrial section on East Sixty-second street.

The new plant, which is being erected for them by the Austin company, will cover nearly two acres and will consist of a main building 100x175 feet, a modern pattern shop, and a model garage—the buildings of the latest type factory construction. They will be equipped with the newest and best machine tools and labor saving devices. The entire plant will be devoted exclusively to the manufacture of Kimball direct flow turbine, and the Kimball improved patented air lift pumps.

New Dredge Attracts Notice

The new Clarke dredge began operations for the Imperial Irrigation District (California) the last of August on a contract which will take the dredges over 300 miles of canals. Reports from Imperial say that the new dredge is attracting particular interest because it removes earth from both sides of the canal at the same time, whereas under the system that has been in force the dredges go down the canal on one side only, returning on the other. This means that, if successful, the Clarke dredge can do the work in just one-half the time and consequently one-half the expense. The dredging of silt is one of the greatest problems of the district, but the Boulder Dam and All-American Canal will relieve the valley of this burden, which runs, including the cost to the farmers themselves, to more than $1,000,000 annually.

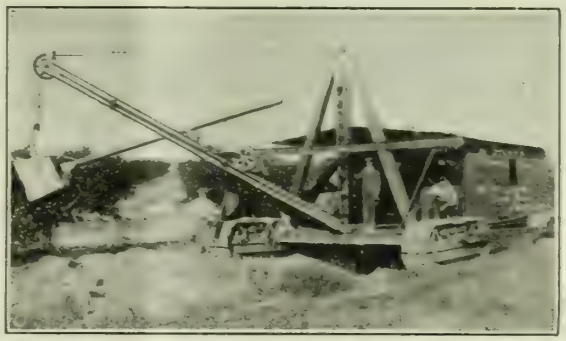
Pipe Line for Famous Ranch

On the famou 20,000 acre Guenoc Rancho near Middletown, California, the property at one time of the celebrated actress Lillian Langtry, the United Concrete Pipe & Construction Company of Merced are constructing a pipe line. They are using a Parson Model 21 ditcher. On this ranch is said to be the largest private dam ever constructed for the impounding of water.

For Cleanout -- Maintenance -- New Ditches

There's a Bay City for Every Job

BAY CITY Land Dredges span the ditch, can dig any desired slope, and dump waste on both banks. BAY CITIES leave clean, wide berms, and can work up or down streams. One trip over the ditch is enough. The Shovel Type Dipper handles hard material in which other types of buckets cannot make a good showing.



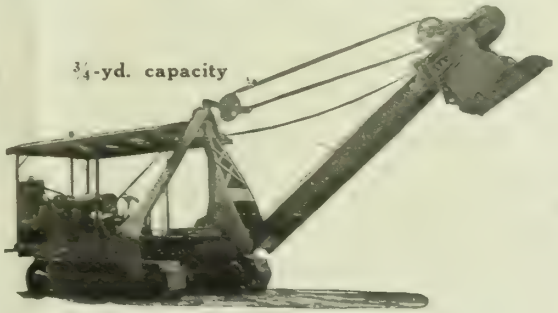
At left—One yard BAY CITY Dredge digging and cleaning ditches in Florida Citrus Groves.

BAY CITY Land Dipper Dredges are built to fit the job. Walking, Crawler, Track or Floating mounting. Easily dismantled, transported and assembled. Capacities ½ to 1½ cubic yards. Oil engine or electric operation.

FOR SMALLER DITCHES — OR PIPE LINE TRENCHES

The BAY CITY 16-B convertible Excavator will handle a wide range of work. Operates Dragline, Trench Shovel, Clamshell or Skimmer. All steel. Shipped assembled. Digs any width or depth up to 20 feet.

STEEL CONSTRUCTION



FULL CRAWLER MOUNTING

or—Model 4 Excavator

BAY CITY Model 4 is a small low-priced convertible, one-man operated Excavator. Fills the gap between hand labor and high priced equipment. Capacity 20 to 40 cubic yards per hour. Gasoline or electric power. A Real Digger economically designed for the small job. Also operates shovel, and clamshell.

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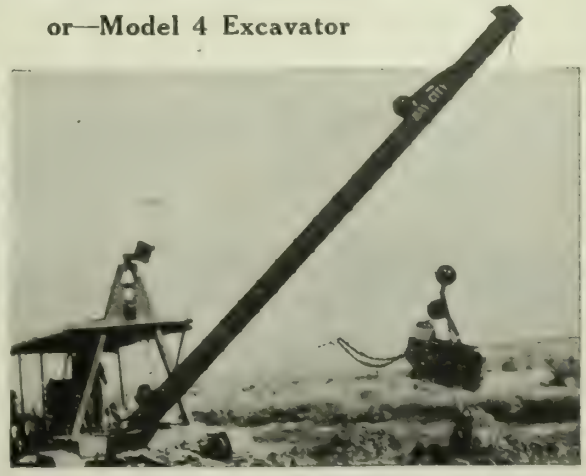

One of the Model 4's Owned by Colorado Irrigation Companies. Cleaning Out Canal.

Our many years experience in manufacturing and operating Dredging machinery is at your service. Write us about your problem.

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RECLAMATION

Hoover Views Reclamation from Tomorrow's Needs--and the Next Day's, and the Next

By HERBERT HOOVER

FOR the past five years the Department of Commerce has, as directed by its organic act, and at the request of the other departments of the government, devoted much of its energies to study of the commercial possibilities in the development of the water resources of our country—inland waterborne transportation, power, irrigation, reclamation and flood control.

The time has come when we must take an enlarged vision of their future. We have arrived at a new era in this development. We have need that we formulate a new and broad national program for the full utilization of our streams, our rivers and our lakes.

Water is today our greatest undeveloped resource. Our streams and rivers offer us a possible total of 55,000,000 horsepower and of this less than 11,000,000 has been developed. Of our 25,000 miles of possible inland waterways probably less than 7000 are really modernized, and the utility of much of these 7000 miles is minimized by their isolation into segments of what should be connected transportation systems.

Vast Area Reclaimed

We still have 30,000,000 acres of possible reclaimable and irrigable lands. And these water resources lie in every part of the union—the great basins of the Columbia, the Colorado, the Sacramento, the San Joaquin, the Mississippi, the Arkansas, the Platte, the Missouri, the Ohio, the Cumberland, the Tennessee, the Hudson, the Great Lakes, the Saint Lawrence, and many others.

True conservation of water is not the prevention of use. Every drop of water that runs to the sea without yielding its full commercial returns to the nation is an economic loss, and that loss in all its economic implications can be computed in billions.

We have for a century and a half concentrated ourselves upon development of our land and our mineral resources; we have conserved our forests and developed our rail and highway transportation. Our government has done some effective work with water, but we have wasted vast sums of public money under political pressures; and we have now skimmed off the easy job. Today it is the major engineering jobs and the opportunity of great national design which lie before us.

The National Outlook

One of the loudest objections that Secretary Hoover hears to his extensive program of utilization of the nation's water resources comes, no doubt, from the agricultural interests, who fear that the bringing under cultivation of additional large areas of land will result in over-production. Hoover's answer to this can best be expressed in his own words:

"I would," he declares, "be opposed to such development myself were it possible to bring it about in a few days. But it must be remembered that these projects take time. Even if the program I have outlined could be started tomorrow it would be at least fifteen years before it would affect agriculture."

Hoover points out that the population of the United States will be increased by 40,000,000 people in the next quarter of a century and that efforts must be made during the next ten years to stimulate agricultural production to provide food for this increase.

The vision of the average agriculturist is hardly able to encompass more than today's and possibly a few of tomorrow's needs. Secretary Hoover looks ahead to the day after tomorrow and to the next day after that. Most of us are so close to our own little problems that we fail to see or even care to see the problems of our neighbor or our neighbor's neighbor. The national outlook is what is needed and Hoover's plan expresses that. "Sectional controversies settle nothing," is the way he puts it. "Water development can be settled only by steam shovels and the pouring of concrete."

—Editor.

Almost unnoticed, the progress of science and engineering has revolutionized the possibilities of our water resources. Inventions in construction methods and tools enable us to economically deepen channels and safely construct great dams.

The discoveries in transmission of electricity now enable distant waterpower to be brought to a market as a vital contribution to the cost of developments for other purposes. We have emerged from the long postponement of national construction imposed by the war and reconstruction; we have recovered so greatly in national wealth that we now have the capital to compass such projects as our expanding needs require and our undeveloped resources make possible.

We must no longer think in terms of single power sites or single storage dams or single land projects, or single navigation improvements; we must think (and thanks to science and engineering we can think) in terms of the co-ordinated long-view development of each river system to its maximum utilization. We have also to face the regrettable fact that these great possibilities of development of water resources are fast drifting into the muck of litigation, political opposition and interstate quarrels, which could be solved by the determination of broad national programs.

I am not proposing that all these things should be done tomorrow. At this moment we could not make economic use of the whole of this power or all this land, or all these inland waterways—but we will need the whole of it within half a generation. And at this moment we have the urgent need for beginning certain major projects which will require years for completion.

*Excerpts from an address delivered on August 21 before the Columbia River Basin League.

Today we are expending on isolated works under the rivers and harbors appropriations and under the reclamation act sums aggregating perhaps at most 65 millions a year. It is my own view that the federal government can well afford to enlarge its financial program in contribution to the great permanent structures; to pour the cement and dig the channels for this great development and to organize such collateral support from the states and collect such returns in by-products as sound procedure and good sense will offer.

An increase by the federal government beginning at $25,000,000 and rising to $100,000,000 a year together with the collateral expenditure of states, local communities and the hydro-electric companies would complete many of our most pressing projects in the next ten years. Much of this expenditure would be directly recovered from land and from leases of by-product power. It is all of it a capital outlay not a disappearing expense.

Realization of these plans will bring economic well-being measurable not in millions but in billions. We could for the immediate projects that lie before us even find a return in money by the increment in federal income tax alone, for the growth of national income and wealth would finance and more than warrant any such national outlay. We are all engaged in the great effort at tax reduction, but a soundly run business house not only looks to its expenditures but it looks for increased revenues. A nation can reduce its tax-rate by increasing its wealth and thus causing a spreading of the burden. These are reproductive works we are talking about. They are not charity to any locality.

We have fortunately grown out of the period of the pork barrel in river and harbor improvements. The distinguished action of Congress by which the broad distribution of appropriations is left to the United States engineers removes from all these proposals the charge of political waste. To have definite policies and plans for each drainage will be a further assurance of efficient expenditure.

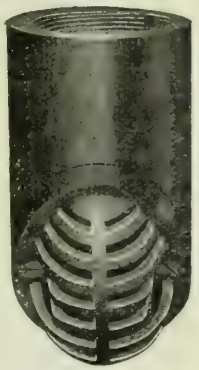
Imperial's Drainage Problems

(*Continued from Page 16*)

feet is now under construction. The first tile placed was an experiment to determine if water could be collected from the tighter soils. The results were quite satisfactory, and it is expected that many miles of the tile will be placed before all the small local areas have protection.

The section used for the open drains varies from 6-foot base, with 1:1 side slopes, to 12-foot base with 1: 1½ side

CLEARFLOW



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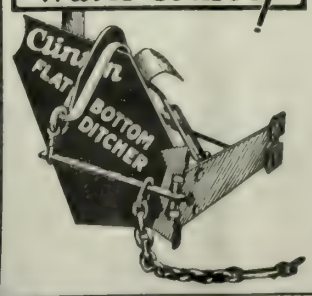

Here are—
5 Advantages:
you'll appreciate in this tool:

1. It builds a ditch which carries more water than a "V" ditch, depth and fall being equal.
2. The "off" horse walks on the flat ditch bottom instead of on the slope.
3. Silt fills this type of ditch more slowly and there is less overflow.
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5. It can be cleaned out with greater ease for it keeps its shape.

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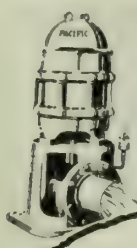

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In order to complete our files, we are appealing to our reader friends asking for the return of copies for which you have no need. In exchange for certain old copies, we will send you copies of current issues, special future numbers or pay you the retail price per copy.

Please Address
Service Department
MODERN IRRIGATION
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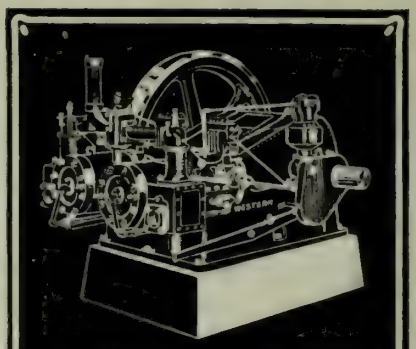
slopes. Depths of cut run from 10 feet to 14 feet; 11 feet being the average sought for with instructions to the machine operators to work one foot below grade. In one case cuts as much as 25 feet were encountered, this being the only way out of the saucer-shaped area known as the Mesquite Lake District.

Modern Structures, Methods

The structures for the drainage system have been somewhat varied, both as to style and materials. Timber bridges of the 3 span type have generally been used for the highway crossings. Ingot iron flumes of the Lennon type are used in the main distributing system wherever possible. In cases where combination structures could be used to pass one or more canals and a highway over a drain, Armco corrugated pipe was specified and placed in the drain. These installations were always made 2 feet below grade to allow for future cleaning and deepening. Armco corrugated pipe has been used instead of flumes for irrigation canal crossings where it was desired to keep the bottom grade of the canal down for sluicing and still be able when required to make a high delivery of irrigation water at the outlet end. This was accomplished by using a high concrete headwall on either end of the pipe.

For the removal of the material in the open sections, draglines were used exclusively and have proved very satisfactory. At one stage of the construction 14 machines were in operation on various drains at one time. On very wet work the machines moved on mats constructed of heavy timbers (generally 8-inch by 8-inch) held together by cables. Mats have been necessary on not over 15 per cent of the work. It has been the rule that where mats were required trouble would be encountered in getting to grade due to the sloughing of the banks. This was overcome by making several light cuts which allowed the banks to drain out a little at each trip over. In no case was the machine operator allowed to stand and fight the material. He was required to take more cuts if necessary. As many as five cuts have been made over a single portion of the drain, but good side slopes with proper grades were finally obtained.

For the tile drain the regulation trencher was used. This equipment operated satisfactorily with one exception. The exception occurred when a very thoroughly saturated adobe dike was encountered and the material would not clean off the buckets. In this case, a dragline being at hand, it was moved onto the job and the section opened up with 1:1 side slopes. When the adobe dike had been passed (some 300 feet) the trencher was returned to the work.



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Sheffield Power Co. Measures Water Flow with Republics

The above illustration shows a panel board with Republic Indicating, Integrating and Recording instruments. These are used by the Sheffield Power Company, Sheffield, Alabama. They average 1,000,000 gallons per day—pumped to the surrounding cities. Every gallon is checked by Republic Water Meters.

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It has been necessary to shore rather heavily on the greater portion of the tile work to prevent the sides from caving in on the workmen. The average cut on the tile drain has been 10 feet.

Continuous Progress

The first drainage work was started in 1922 and has been in progress continuously since that time. A total of 175 miles of drains, involving the excavation of nearly 9,300,000 cubic yards of material, have now been constructed. The average cost per yard, including a plant charge, is $.087. At the present time an additional 25 miles of open drains are contemplated. This will not completely drain the irrigated portion of the valley, which is about 500,000 acres, but will exhaust the funds now available. It is estimated that at least 100 additional miles of drains will be required to come near completing the drainage system. This is believed to be the largest drainage problem of any irrigation project.

With this great mileage of open drains constructed and contemplated, the district is faced with a real maintenance problem. So far as is known, very little machinery has been designed especially for the care of deep drains. The condition has been met rather satisfactorily by using light, fast machines equipped with ½-yard clam shell buckets. The true center line of the drain is staked by high splines, and the vegetation, such as tules and small willows, is cleaned from the side slope on the machine side and to a point three feet past the center line toward the opposite bank. The remaining vegetation is not removed as it is considered an asset to the maintenance. The clam shell then digs a very narrow trench on the center line of the drain. The roots of the vegetation hold the material from slipping into the trench, and the vegetation on the bank tends to shade the channel. The water course being narrow, the velocity is therefore speeded up which further restricts the growth of the vegetation. This method is quite expensive, costing about $450.00 per mile, one machine being able to cover from 4 to 4½ miles per month. However, one thorough cleaning is good for two years and it is believed that with lighter and cheaper machines than the ones used, which were on hand, the cost can be materially reduced.

The construction work has been handled entirely by force account methods. D. W. Murphy, consulting engineer, of Los Angeles, prepared the original plans. M. J. Dowd, as general superintendent of the Imperial Irrigation District, is the executive head, and the writer is directly in charge of field engineering and construction work.

Announcement

Engineers, Contractors, Public Officials and Others Interested are Cordially Invited to Attend

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FOR

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WHO'S *WHO* AND WHO'S *WHERE*

IN THE WORLD OF HYDRAULICS

Personal Notes and Impersonal Observations About Men You Know

C. H. Howell, engineer in the Denver office of the Bureau of Reclamation, has resigned to accept a position with the middle Rio Grande conservancy district.

William S. LaLonde, Jr., of the city engineer's office of Los Angeles, has recently been appointed instructor in civil engineering at the University of Nebraska.

Walker R. Young, who made the survey for the Boulder canyon dam in the Colorado river, is construction engineer in charge of the work being carried on in the Kittitas division of the Yakima project, Washington.

W. F. Bemister has been appointed by the Canadian National Railways as supervisor of fire protection for the western region, with headquarters at Winnipeg, Manitoba. He succeeds W. J. F. Craig, deceased.

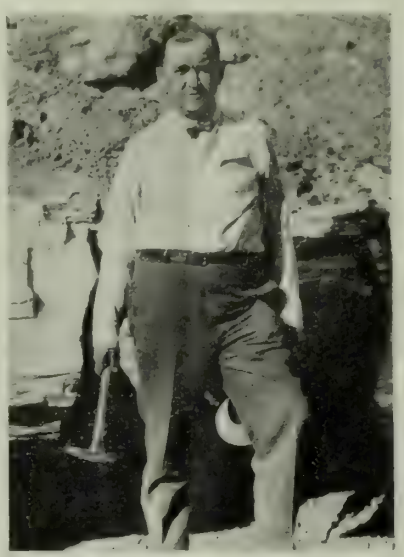
J. J. Hubbell, who has been with the Gila River irrigation project in Arizona, has been transferred to Washington, where he will take charge of the Lummi reservation project under which 4000 acres of tide lands are to be reclaimed.

J. L. Lytel, superintendent of the Yakima project, Washington, reports that the project is closing an unusually successful irrigation season, although the extremely dry winter of 1925-1926 has made it necessary to handle the water with the greatest care.

Ora McDermith, for the past five years consulting engineer of the Kittitas reclamation district, with headquarters at Ellensburg and Seattle, Washington, has been appointed consulting engineer for the entire reclamation service. His first assignment in his new position will be on the Carlsbad project in New Mexico.

Walter L. Drager, has resigned his position as construction engineer with the U. S. Bureau of Reclamation, Denver, and has been appointed construction engineer with the J. G. White Engineering Corporation on the Santiago Dam at Aguas Calientes, Mexico. The Santiago project, one of the divisions of Mexico's irrigation program, will cost according to estimates, $4,000,000.

Porter J. Preston, manager of the Yuma project, is one of a commission appointed by the U. S. Reclamation service to investigate the cost of operating reclamation or irrigation projects, both public and private. During their itinerary the commission will visit more than forty irrigation projects in the west. Later in the fall they will visit Yuma and check over the cost of operating the Yuma project.



A GOVERNOR IN ACTION

The photograph shows James Graves Scrugham, chief executive of the State of Nevada, on a recent trip of investigation of certain of the state's mineral resources. Governor Scrugham has written for Modern Irrigation an article on "What Irrigation Has Done for My State—Nevada," which appears in this issue.

Frank C. Emerson, state engineer for Wyoming, is the Republican nominee for governor. Mr. Emerson was appointed state engineer in 1919, and in 1921 was reappointed by Governor Carey for six years. He was removed by the late Governor Ross for alleged misconduct in connection with the confirmation of his appointment by the Senate. Mr. Emerson contested this removal and was reinstated by the state supreme court in January, 1924.

Joseph L. Burkholder, who drew the plans for the Elephant Butte project in New Mexico, was chief honor guest at a banquet given the officials of the Elephant Butte Irrigation district during a recent conference held there.

Secretary Hubert Work addressed the Western States Convention at Denver, Colorado, on the subject of "Public Lands." He stated that he believed a revision of the public land laws was necessary—that many of the statutes now being administered were enacted to meet pioneering conditions. He is in favor of a repeal of the stockraising homestead act and of the desert land act, and thinks that a law authorizing the establishment of grazing districts should be enacted.

W. M. Reed, chief engineer of the United States irrigation service, on his recent annual trip of inspection, is quoted as saying that the Yakima Indian Reservation Irrigation project is the most prosperous of the ninety-odd projects the service is operating today. That project is not only the largest at the present time, Mr. Reed says, but is the most productive. The bureau keeps an accurate check of the amount and nature of the crops raised on each of its projects, so that there is no guess work about it.

The South African Government is taking a wide-awake interest in matters of irrigation. H. R. Roberts, of the irrigation department of the Union of South Africa, and D. G. Collett, chairman of the Irrigation Board of Graaf Reinet, South Africa, have been inspecting various projects in the west, while word comes from the Denver office of the Bureau of Reclamation of a recent visit from S. B. Shannon and N. Shand, engineers from the irrigation department of the South African Government who are visiting in this country for about a year and are making a study of American irrigation projects.

Water Shortage Damages Crops

Among the irrigation projects of the Bureau of Reclamation crop damage from shortage of water is certain on the Okanogan project in Washington, according to a statement issued in August by the Department of the Interior.

Minor crop damage can be averted only by unusual summer rains on the Yakima project in Washington, the Boise and Minidoka projects in Idaho, and the Milk River and Sun River projects in Montana by reason of depletion of storage on which these projects are largely dependent in late summer. On the Yakima project much water has been lost through illegal diversion of project water by other interests. A threatened severe shortage on the Truckee Division of the Newlands project, Nevada, has been materially reduced by initial steps in administration of Truckee River waters in accordance with a pending adjudication decree.

Unusual rains in early summer, combined with newly completed pumping installations, have removed all danger of shortage on the Salt River project in Arizona.

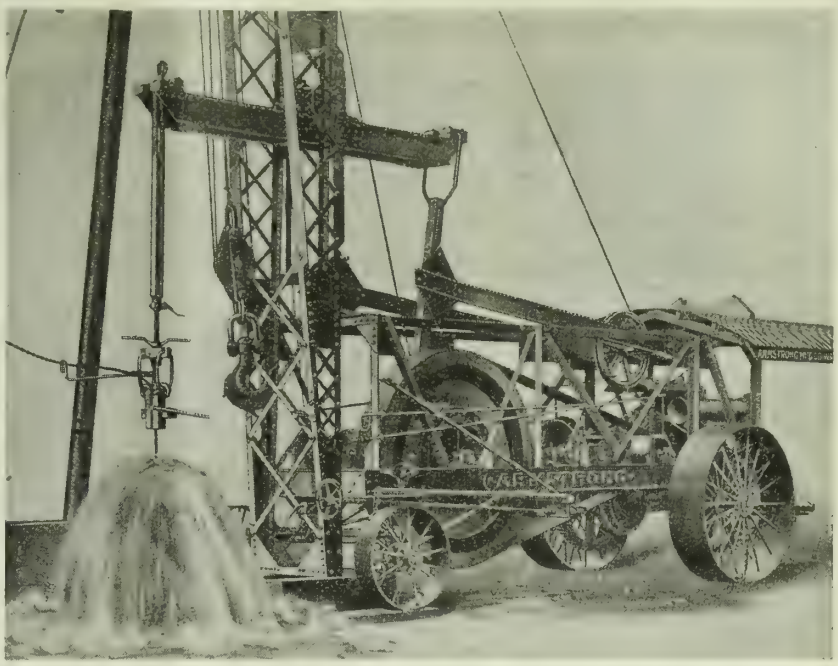
Classify Western Lands

Classification of 20,000 acres of public land in the State of Oregon as valuable for water-power purposes was made public in August by the Interior Department in connection with the land classification report of the Conservation Branch of the Geological Survey for the month of July, 1926.

The report shows that nearly 9,000 acres of public land in Arizona and Nevada were included in formal orders designating the land as nonirrigable under the enlarged-homestead act and to that extent subject to entry as homesteads of 320 acres or less. More than 100,000 acres in Idaho, Montana, Nevada, New Mexico, Washington, and Wyoming were classified under the stock-raising homestead law and designated for entry in tracts of 640 acres or less. Much of the acreage involved in these designations is included in original entries or in applications under the enlarged and stock-raising homestead acts which confer a preference right.

Seeks to Cancel Contract

The Medford Irrigation district (Oregon) has applied to Rhea Luper, state engineer, for approval of a resolution adopted by the district for cancellation of a contract with the Rogue River Canal Company for the construction of an irrigation district. It is charged by the petitioners that the canal company has failed to comply with the provisions of the contract.



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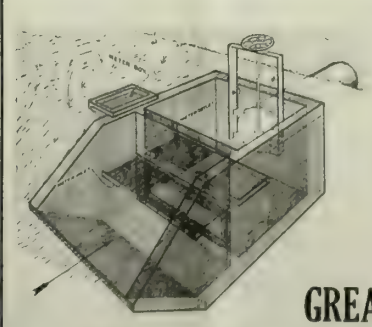

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LEGAL *and* JUDICIAL

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Irrigation District Is Public Corporation

Wyoming irrigation district law upheld by Supreme Court.

In defining the status of an irrigation district under the laws of Wyoming the Supreme Court in the case of Sullivan vs. Blakesley, et al., 246 Pac. 918 (June 15, 1926) states:

"An irrigation district, reclaiming, as it does, desert lands of the state, and accordingly conferring a benefit, not alone upon the private individuals within the district, but also upon the people of the state as a whole, is a public, rather than a private, corporation." . . . . "Such districts have at times been designated as municipal corporations, and they might be such within the meaning of laws or constitutional provisions not now under consideration, but it is clear that they are not municipal corporations as generally understood. They are merely special state organizations for state purposes with limited powers, created to perform certain work which the policy of the state requires or permits to be done, and to which the state has given a certain degree of discretion in reclaiming desert lands."

This case also brings up the old controversy as to whether or not bonds issued by an irrigation district constitute a general lien obligation of the district, citing cases holding both ways. The court states:

"The difference in opinion as to the character of such bonds may, to some extent at least, be accounted for by the difference in the laws of the several states. . . . ."

Evidence Must Show Intentional Abandonment

Failure to keep system in repair though strong evidence is not conclusive. Strong evidence is necessary to show abandonment of reservoir.

In the case of Munson v. Schade, 247 Pac. Rep. 454 (Colo. June 7th, 1926) a question was raised as to the sufficiency of the evidence to sustain a finding of the court against a question of the abandonment of a reservoir.

The evidence was to the effect that the irrigation scheme in controversy was originally impracticable; that the reservoir and dam had only been used to a very limited extent, was out of repair and had been more or less abandoned. The ditch system, however, had been used, although not under the original scheme of irrigation.

The Supreme Court of Colorado held:

"The reservoir was a part of their general plan; the use of the water was another part; and, while it requires strong evidence to show the abandonment of a valuable right, not less if not more does it require to show an abandonment of a valuable part of a system while the remainder is maintained."

Various excuses were offered at the trial of the case for a failure to keep the system in repair, such as the poverty of the owner of the system, the desire for sub-irrigation, etc.

In reply to these points the court states:

"The real question is, What did these several consecutive owners intend? The court has found in favor of the defendants on that point, (No intentional abandonment) and, though their long delay in repairs is strong evidence against them, yet we cannot say that it is conclusive."

Court O. K.'s Bean Growers' Expenditures

The use of money to properly influence legislation is not against public policy.

A decision which is of interest to those who are following the fortunes of the case of Crawford vs. Imperial Irrigation District now pending before the Supreme Court, was rendered by the Supreme Court of the State of California on August 2, 1926, in the case of California Bean Growers' Association vs. Rindge Land & Navigation Company, 72 Cal. Dec. 149.

In this case the Association had expended certain moneys in an effort, by having representatives appear before Congress and its committees, to have the tariff rates on beans increased. The defendant claimed this was an unlawful expenditure of the Association's money. The court states:

"No attempt was made to show the particular purpose for which the money was used or for what it was illegally or improperly expended. It is neither illegal nor improper to expend such reasonable sums as may appear to be necessary to present, by fair and open means, the merits of any matter advocated before a legislative body (6 Cal. Jur. 126). It is to be presumed, in the absence of evidence to the contrary that such means were employed."

In the Crawford case the Imperial Irrigation District had employed an agent to appear before Congress and its committees concerning the Boulder Canyon Project. The trial court held that any payment to this agent was unlawful.

"Arid Region Doctrine" Versus State Laws

Under laws of New Mexico all water questions are controlled by statutes.

In the case of Harkey v. Smith, 247 Pac. Rep. 550 (New Mexico, Apr. 17, 1926), the Supreme Court of New Mexico reviews the law concerning water rights as affected by the Statutes of that State, stating:

"It may be stated generally that, under the arid region doctrine, uncontrolled by statute, the appropriation of water is accomplished by the taking or diversion of it from a natural stream or other sources of water supply, with intent to apply it to some beneficial use or purpose, and consummated within a reasonable time by the actual application of the water to the use designed, or some other useful purpose. . . . . Under this doctrine it is quite as necessary to make use of the water as it is to divert it, in fact, no appropriation can be effected without such use. The intent, diversion and use must coincide.

"As a result of this doctrine, there flows naturally and necessarily the further doctrine of periodical or seasonable appropriation. If a farmer makes use of the water for the irrigation of his crops only during the growing season, say from March 15th, to October 15th of each year, the same may be appropriated by a mill owner for power purposes, by a placer miner for the washing of his gravel, or by another farmer for irrigation purposes, or by another for storage for future use, during the remainder of the year. This is the established doctrine everywhere, in the absence of statutory regulations.

"We have, however, a statute in this state, (New Mexico) regulating the acquisition, means, and manner of enjoyment of water rights which controls the whole matter, and which marks a wide departure from the doctrine above stated."

In applying the statutory provisions of the water act of that state the court further held:

"A careful re-examination of this legislation convinces us that there has been a departure from the old arid region doctrine of appropriation and seasonal or periodical appropriation, and that now the right to the use of water, either as to volume or periods of use, is regulated either by the permit of the State Engineer, or the decrees of the courts. It is, of course, true "that beneficial use shall be the basis, the measure, and the limit of the right to the use of water," as is provided by the constitution. But this provision merely declares the basis of the right to the use of water, and in no manner prohibits the regulation of the enjoyment of the right."

(*Continued on Page 53*)

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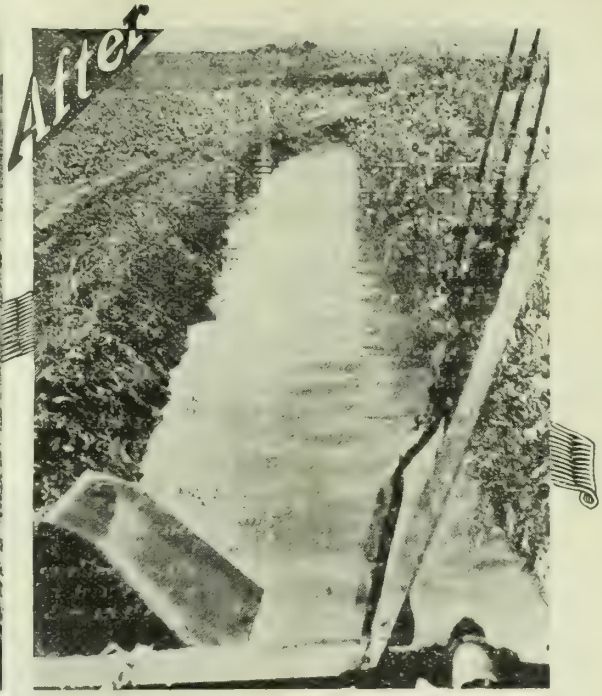

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OVERHEAD IRRIGATION

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"OVERHEAD" HAS CAST ASIDE ITS SWADDLING CLOTHES

By FINGAL C. ORR, M. E.*

OVERHEAD irrigation may now be considered as having come to stay. It has passed through the experimental stage and has proved its advantages as to conservation of water, saving of labor, reduction of upkeep on tools, etc. Through the three years just past it has emerged from what was regarded as a doubtful experiment into a practical success.

The honor due for the results obtained lies with those pioneer growers who devoted their time and money to the earlier trials, and who, having the courage of their convictions, were not afraid to take a chance.

The earliest grove in which overhead irrigation was installed, so far as the writer has been able to learn, was located at Covina, California. The system there was installed about fourteen years ago. Then followed several installations of a portable nature in Sierra Madre and vicinity, and at least one located at La Canada and another at Glendale. What might be considered the first practical installations of a strictly modern type were located at San Gabriel, California, on the Sunny Slope Water Company's lines.

On a Stable Basis

The commercial end of the overhead irrigation enterprise may also now be considered as fairly well on its way towards satisfactory organized endeavor. Of course during the early days, while the business was still in the "growing pain" stage, as it were, there were the usual crop of "fly by night" outfits who broke into it, ready enough to start something but lacking the stability to finish, who made some very regrettable installations, thrown in without due regard to the engineering requirements of the case in hand. Fortunately for the development of the business, these cases were not numerous and the harm done was more than offset by the satisfactory work of the men who were qualified.

During this period it was naturally hard for the grower to know who was, or was not, competent to undertake this work. Many people have asked the writer whether it was necessary to employ the services of a fully qualified engineer to make the necessary pipe layout

FINGAL C. ORR

on paper for a proposed installation. It is the writer's belief that it is, of course, well to be sure that the man doing this knows his business. There are quite a few men, who do not claim full qualifications as engineers, but who have made an intensive study of this particular and practically new branch of hydraulic engineering, and they are making thoroughly satisfactory installations. These men might be termed overhead irrigation specialists. For the most part they are men who have had years of experience in the pump business and were, therefore, prepared to take up the new business when the need arose. Should one have any doubt, however, as to the correctness of a proposal, it is only a matter of having it checked over for possible mistakes by any hydraulic engineer experienced in this line of work.

Approves Reconditioned Pipe

The question has been raised from time to time as to the advisability of using reconditioned pipe for this purpose. The experience of the writer would tend to show that, as long as the pipe is free from pits, blisters, and other blemishes, and is treated with a coat of petrolastic cement both inside and out, there is no reason why it should not last the life of any grove. It must be borne in mind, however, that in securing this grade of material one must be careful to obtain same from a reliable firm which makes a practice of thoroughly cleaning the pipe, both inside and out, before dipping it in the hot solution. In order to obtain the best results, it is necessary for the metal to be left in the hot liquid until both are of the same temperature.

The lasting qualities of a pipe are in proportion to its thickness of wall, the larger pipes being usually much heavier in the wall than those of smaller diameter. It has been my experience that the fewer pipes laid of small diameter the better. I have, therefore, always advocated strongly the large coverage sprinkler, the modern types of which give a thoroughly satisfactory distribution of water.

The question of how much water to lay down in a given number of hours is a matter controlled by many factors, such as soil porosity, the actual number of gallons per minute of water available, and the extent of the acreage to be covered. Where the volume of water is not restricted, it is a matter best decided by the grower himself. It depends upon how heavy an irrigation he wishes to apply and the number of hours he desires to do it in. This information in the hands of one competent to use the necessary figures will enable him to determine the size of pipes, etc., necessary to handle the situation with the greatest efficiency.

*Mr. Orr is one of the pioneer engineers who conceived the idea of putting overhead irrigation on a sound engineering basis. He is the inventor of a number of devices now on the market which first made possible economic, wide coverage.

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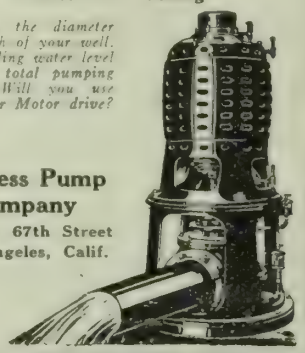

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OVERHEARD AMONG THE *OVERHEADS*

Various overhead irrigation installation contractors, operating from Los Angeles headquarters, report many new jobs recently contracted. The prospects are for by far the largest fall and winter installation boom on record, they believe.

The numerous requests from far and near for information on overhead irrigation systems that are being received by the Thompson Manufacturing Company attest to the wide and rapidly growing interest in this most modern means of irrigation. The sizes of the installations contemplated vary from one to six hundred acres.

For the efficient operation on low pressure the seven-and-one-quarter-acre system on the ranch of E. D. Ingalls in north-east San Diego county is asserted to set a new record. The Rainlyk sprinklers are set to cover five trees net to each sprinkler and the coverage with a rain like shower with only fifteen pounds pressure is said to be very even. The system was designed by Lippincott and Stewart.

The avocado growers' field day tour, conducted in connection with the Los Angeles County (Calif.) Farm Advisor's office, to view avocado groves irrigated with sub-irrigation, basin and furrow methods, and with overhead systems, was one of the most interesting ever fostered by these two active organizations. It was held on Wednesday, Sept. 15. Details of the tour will be discussed in the October number.

A new sprinkling system, remarkable for its completeness has just been installed on the athletic field of the El Monte, Cal., High School by the Hadden Automatic Sprinkler Company. The two-acre plot of light, dusty soil has been forced, through frequent applications of the proper amounts of water, automatically controlled, and by means of liquid fertilizer applied through the system, to grow a turf in a little over six weeks' time that is expected to stand the fall football practice at that institution.

An old landmark in the overhead irrigation field has just passed with the taking over by the Western Pipe and Machinery Co. of the pipe yard and business in Los Angeles of Samuel H. Gerson. A. Lutz is the new proprietor.

Several of the present overhead irrigation contractors were connected with the Gerson yard at one time or another during the early stages of development of the overhead business. Gerson was the first of the pipe yard owners to become interested in using re-conditioned pipe in overhead systems, having first secured favorable results from such a system on a lemon grove of his own at Sierra Madre.

"Trouble shooting" on overheard irrigation installations is, to say the least, a new business and as it is one that has few precedents to go it frequently tests the ingenuity of those whose services are called upon. Although some of the cases are so serious as to necessitate "major operations"—that is, extensive remodeling of the systems—it is frequently found that a simple auxiliary device or a change in schedule of nozzle will remedy a situation seemingly hopeless to the grower.

A system in Orange county had from the first given trouble from asphalt, pipe scale and canal detritus stopping up the screen boxes, riser screens and small sprinkler openings. The work attendant on operating such a system grew more irksome than in irrigating with the old furrow method, and the grower after getting little satisfaction in endeavoring to eliminate the various points of trouble was on the verge of returning to the old method.

When a "trouble shooter" from Lippincott and Stewart was called in two of the mains and several of the laterals were found to be from one-half to two-thirds full of material that would have passed through the major nozzle if proper sized riser screening, with a properly maintained pressure had been employed. Flushouts were installed, proper meshed riser screens and special screen devices to protect the minor nozzles from plugging were provided and the system, fundamentally o. k., is now functioning to the grower's satisfaction.

Refusal to Supply Water Upheld

The California Railroad Commission has dismissed the complaint of A. O. and Martha L. Barnes against East Gardena Water Company, in which the Railroad Commission was asked to require defendant utility to extend its mains to complainant's property. It was shown at the hearing of the complaint that the facilities of defendant utility were taxed to the limit to supply present consumers.

For Detailed Listings, Branch Offices, Etc., See the Buyers' Guide to Leading Supply Sources—Pages 55-56

WHAT IS *YOUR* PROBLEM

In this department, questions of general interest to overhead irrigators will be answered for our readers. Should special or earlier answers be desired, a stamped addressed envelope should accompany each inquiry. There is no charge for this service.

How much can I save by installing an overhead system myself on six and three-fourths acres? G. L. P., Tulare County, Calif.

It is doubtful whether you could save anything by doing the work yourself, even at your distance from the center out of which most of the overhead irrigation contractors operate. The experience that contractors have acquired in doing many jobs would, generally speaking, assure certain economies and expeditious workmanship, the benefits from which would accrue to you under a fair agreement with a contractor willing to operate at that distance away from his base.

We have in mind one careful grower who was going to learn all about overhead irrigation installations, sprinklers, layout, etc., in a few weeks; then buy the best equipment, install it himself and set a new mark for operating efficiency. He based his confidence on his practical experience in other construction lines. His overhead system, however, has cost over five hundred dollars per acre, is badly sand trapped, and he is still looking around for sprinklers to throw odd shapes to avoid excessive overlaps in places and to cover the spread on the low pressure sections, etc.

Can you tell me if overhead irrigation is practical and economical in growing alfalfa on level sandy loam soil? E. T., Los Angeles County, Calif.

The opinion of the University of California experts delegated to study and report on overhead irrigation was to the effect that overhead irrigation is costly, this factor limiting its use to valuable crops.

The investment per acre would be considerable for land on which to crop alfalfa permanently, or for ten years, let us say, and it is a question whether the increased production would carry the investment interest charge and depreciation and show a profit in competition with cheap land and water producing the same.

If you planned to build up the soil humus preparatory to planting to other more valuable crops or trees which would thrive under overhead irrigation, the installation at this time would, of course, be advised.

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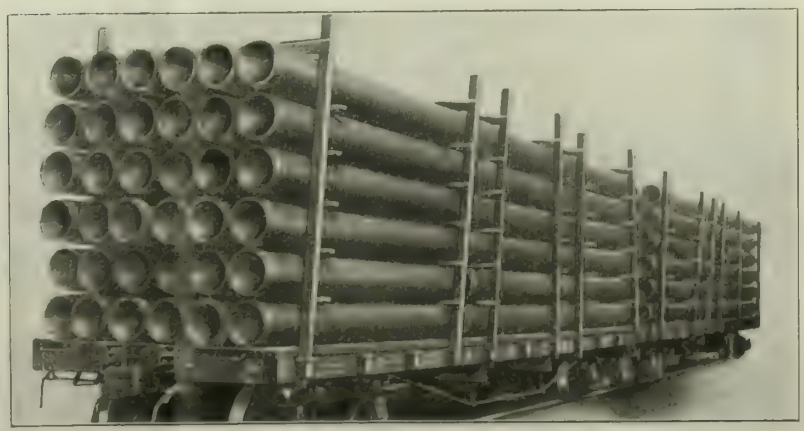

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SURVEY *of* HYDRAULIC DEVELOPMENT

As Shown by Official Records of the Month -- Local, State, and Governmental

Applications Filed

Among the applications for permit to appropriate water filed with the State Department of Public Works Division of Water Rights (California), during the month of August, 1926, were the following:

Application No. 5140 (Riverside County)—Henry M. Jones, care of Oliver P. Ensley, Hemet, Calif., for 1 cubic foot per second from Poppet Creek tributary to San Jacinto River. To be diverted in Section 21, T 4 S, R 1 E, S. B. M. for power purposes in Section 21, T 4 S, R 1 E, S. B. M. 14 T. H. P. to be developed. Estimated cost $1,500.

Application No. 5141 (Shasta County)—James A. Hubbard and W. C. Blagrave, care of W. D. Tillotson, N. Calif. Nat'l. Bank Bldg., Redding, for 125 cubic feet per second and 9600 acre feet per annum from Clear Creek tributary to Sacramento River. To be diverted in Section 22, T 32 N, R 6 W, M. D. M. for irrigation and domestic purposes on 19,200 acres in T 31 N, Rgs. 5 and 6 W, M. D. M. Estimated cost $380,000.

Application No. 5143 (Butte County)—State Land Settlement Board, care of C. M. Wooster, 915 Mission St., San Francisco, Calif., for 20 cubic feet per second from Butte Creek tributary to Sacramento River. To be diverted in Section 5, T 21 N, R 2 E, M. D. M. for irrigation purposes on 3450 acres on Durham State settlement.

Application No. 5144 (Sierra County)—G. R. Holcomb Estate Co., R. F. D. No. 1, Reno, Nevada for 28,000 acre feet per annum from Little Truckee River tributary to Truckee River. To be diverted in Section 16, T 19 N, R 15 E, M. D. M. for irrigation purposes on 6,000 acres in T 18 and 19 N, Rgs. 19 and 20 E, M. D. M. Estimated cost $150,000.

Application No. 5145 (Butte County)—Maude C. Maddrill, care of Jerome D. Peters, Bank of Italy Bldg., Chico, Calif., for 15 cubic feet per second and 4,000 acre feet per annum from Clear Creek via Butte Creek tributary to Sacramento River. To be diverted in Section 4, T 21 N, R 2 E, M. D. M. for irrigation purposes on 1042 acres in Sections 7, 8, 9, 17 and 18, T 21 N, R 1 E, M. D. M.

Application No. 5147 (Inyo County)—Pacific Lead Mines Incorporated, 1111 Stock Exchange Bldg., Los Angeles, Calif., for 0.25 cubic foot per second from Unnamed Spring tributary to Death Valley. To be diverted in Section 28 or 34, T 12 S, R 45 E, M. D. M. for mining and domestic purposes. Estimated cost $2,000.

Application No. 5148 (Santa Cruz County)—Felton Water Company, Felton, Calif., for 0.26 cubic foot per second from Limestone Brook and Scott Creek tributary to San Lorenzo River. To be diverted in Rancho Canada del Rincon for irrigation purposes on 700 acres in Sections 20 and 21, T 10 S, R 2 W, M. D. M. and Ranchos Canada del Rincon and Zayante. Estimated cost $10,000.

Application No. 5149 (Santa Cruz County)—Felton Water Co., Felton, Calif., for 0.26 cubic foot per second from Limestone Brook and Scott Creek tributary to San Lorenzo River. To be diverted in Rancho Canada del Rincon, for municipal purposes in Felton, Felton Acres and vicinity. Estimated cost $10,000.

Application No. 5150 (Santa Cruz County)—Felton Water Co., Felton, Calif., for 0.26 cubic foot per second from Limestone Brook and Scott Creek tributary to San Lorenzo River. To be diverted in Rancho Canada del Rincon, for domestic purposes in Sections 20 and 21, T 10 S, R 2 W, M. D. M. and Ranchos Canada del Rincon and Zayante. Estimated cost $10,000.

Application No. 5153 (San Joaquin County)—Theodor Lorenzen, care of Ohm and Raab, 517 E. Market St., Stockton, Calif., for 12.34 cubic feet per second from San Joaquin River tributary to Suisun Bay. To be diverted in Section 22, T 2 S, R 6 E, M. D. M. for irrigation purposes on 987.6 acres in Sections 15, 16, 20, 21, 22, 28, 29 and 32, T 2 S, R 6 E, M. D. M. Estimated cost $16,000.

Application No. 5155 (San Joaquin County)—Island Recl. Dist. 2062, Banta, Calif., for 50 cubic feet per second from San Joaquin River, Old River and Paradise Cut tributary to San Joaquin River. To be diverted at 5 points in El Pescadero Rancho for irrigation purposes on 3938 acres in El Pescadero Rancho.

Application No. 5158 (Mono County)—Lloyd Summers, Mammoth Lake, Calif., for 0.50 cubic foot per second from Dry Creek tributary to Owens River. To be diverted in Section 32, T 3 S, R 27 E, M. D. M. for domestic purposes on tract to be subdivided in Sections 33, 34 and 35, T 3 S, R 27 E, M. D. M. Estimated cost $15,000.

Application No. 5159 (Mono County)—Edson M. Scofield, Mammoth Lakes, Calif., for 0.05 cubic foot per second from Mill Creek tributary to Mammoth Creek. To be diverted in Section 16, T 4 S, R 27 E, M. D. M. for domestic purposes for 12 cabin sites in Sec. 16, T 4 S, R 27 E, M. D. M. Estimated cost $1,000.

Application No. 5160 (Sutter County)—Commercial Investment Co., care of Drury Butler, Court House, Sacramento, Calif., for 1.75 cubic foot per second from Sacramento River tributary to Suisun Bay to be diverted in Sec. 11, T 11 N, R 2 E, M. D. M., for irrigation purposes on 140.07 acres in Secs. 11 & 14, T 11 N, R 2 E, M. D. M. Estimated cost $3.000.

Application No. 5161 (Alpine County)—Pacific Gas & Electric Co., 245 Market St., San Francisco, Calif., for 9,412 acre feet per annum from Deer Creek tributary to N. Fk. Mokelumne River to be diverted in Sec. 5, T 8 N, R 19 E, and re-diversion in Sec. 33, T 8 N, R 16 E, M. D. M. for power purposes in Sec. 24, T 7 N, R 13 E, M. D. M. 14,170 H. P. Estimated cost $600,000.

Application No. 5169 (Nevada County)—C. S. Wheeler, Wheelerville via Reno, Nevada for 49,000 acre feet per annum from Little Truckee River tributary to Truckee River to be diverted in Sec. 4, T 18 N, R 17 E, M. D. M. for irrigation and domestic purposes on 25,000 acres in T 18 N, R 19 & 20 E; T 19 N, R 18, 19 & 20 E; T 20 N, R 19 & 20 E, M. D. M. Estimated cost $500,000.

Application No. 5170 (Nevada County)—C. S. Wheeler, Wheelerville via Reno, Nevada for 500 cubic feet per second from Truckee River tributary to Pyramid Lake to be diverted in Sec. 28, T 18 N, R 17 E, M. D. M. for power and domestic purposes in Sec. 30, T 18 N, R 18 E, M. D. M. 11,023 H. P.

Application No. 5174 (Mariposa County)—Daniel McFarland, Storrie, Plumas Co., Calif., for 2000 cubic feet per second from Merced River tributary to San Joaquin River to be diverted in Sec. 2 (approx. location), T 5 S, R 15 E, M. D. M. for power purposes. 13,750 H. P. Estimated cost $400,000.

Application No. 5175 (Siskiyou County)—John Hodgdon, Box 21, Yreka, Calif., 12.5 cubic feet per second from Middle Fork Humbug Creek tributary to Klamath River to be diverted in Sec. 15, T 45 N, R 8 W, M. D. M. for mining and domestic purposes in Secs. 10, 11 & 15, T 45 N, R 8 W, M. D. M.

Application No. 5176 (Mariposa County)—J. J. O'Connell, care of Claude B. Boyton Co., 119 E. Broadway, Glendale, Calif., for 3600 acre feet per annum of flood waters of W. Fork Chowchilla River tributary to Chowchilla River to be diverted in Sec. 14, T 6 S, R 19 E, M. D. M. for recreational purposes. Estimated cost $110,000.

Application No. 5179 (San Bernardino County)—Thomas O. Williams, Yermo, Calif., for 25 cubic feet per second from Mojave River tributary to Mojave desert to be diverted in Sec. 26, T 10 N, R 3 E, S. B. M. for irrigation and domestic purposes on 2000 acres. Estimated cost $30,000.

Application No. 5180 (San Mateo County)—Islam Redwoods Shrine, care of Francis Keasling, Chronicle Bldg., San Francisco, Calif., for 500 acre feet per annum from Pescadero Creek tributary to Pacific Ocean to be diverted in Sec. 8, T 8 S, R 3 W, M. D. M. for irrigation of golf course, parks and gardens. Estimated cost $25,000.

Application No. 5181 (Butte County)—W. C. Stevens, care of Polk & Robinson, Chico, Calif., for 2000 acre feet per annum from Butte Creek tributary to Sacramento River to be diverted in Sec. 4, T 21 N, R 2 E, M. D. M. for irrigation purposes on 1,740 acres in Secs. 16, 18, 19, 20 & 21, T 21 N, R 1 E, M. D. M.

Power Developments

The Federal Power Commission at its August meeting voted to authorize the issuance of the following licenses and permits affecting projects in the western states.

Project No. 662. To Best Flume & Power Company, of Pinedale, Wyoming, a license for 15 years for a constructed project on Pine Creek, in Sublette County, Wyoming. The principal works of the project consist of a head gate diverting water through a flume about 1-10th mile in length to a power house, and a transmission line about two miles in length. The installed capacity is 65 horsepower, and the developed power is supplied to the town of Pinedale for electric lighting.

Project. No. 683. To Prairie Power Company of Prairie City, Oregon, a preliminary permit for two years for a proposed power project on Strawberry Creek, a tributary of John Day River, in Grant County, Oregon, and within the Malheur National Forest.

No. 736. W. R. Vandeveer of Ophir, Colorado has applied for a license for a constructed project on Bilk Creek in Montezuma National Forest, San Miguel County, Colorado. The project is less than 100 horsepower, and consists of a diversion dam, flume, pipe line, power house with a four-foot Pelton wheel, and necessary air-compressor machinery. The energy is used for mining purposes.

The Commission also authorized the application of the Los Angeles County Flood Control District for a right of way for a reservoir authorized by the Interior Department under the provisions of the acts of 1891 and 1898 on San Gabriel River, California, at the Twin Forks Site.

Permits Issued

Among the more important permits to appropriate water issued by the Department of Public Works, Division of Water Rights of California, during the month of August, 1926, were the following:

Permit No. 2587, Application No. 4926 (Nevada County) Issued to Jonas Hirsch, Reno, Nevada, August 10, 1926 for 0.37 cubic foot per second from Juniper Creek in Sec. 34, T 18 N, R 17 E, for irrigation of 30 acres, for domestic and fire protection near point of diversion. Estimated cost $2,000.

Permit No. 2588, Application No. 5000 (Nevada County) Issued to Jonas Hirsch, Reno, Nevada, August 10, 1926 for 1 cubic foot per second from Juniper Creek in Sec. 34, T 18 N, R 17 E, for power purposes in Sec. 34, 26 T. H. P. to be developed.

Permit No. 2589, Application No. 4920 (Mono County) Issued to Lloyd Summers and U. S. Forest Service, Bishop, Calif., August 11, 1926 for 0.15 cubic foot per second from two unnamed springs in Sec. 4, T 4 S, R 27 E., for domestic purposes at Mammoth Camp Resort, Mammoth Hotel and U. S. Rangers Station. Estimated cost $5,000.

Permit No. 2590, Application No. 4942 (Contra Costa County) Issued to Rindge Land Reclamation Dist. No. 2036, Stockton, Calif., August 12, 1926 for 30.8 cubic feet per second from Old River, Rock Slough & Indian Slough, movable points of diversion in Secs. 1, 11, 12, T 1 N, R 3 E, Sec. 36,

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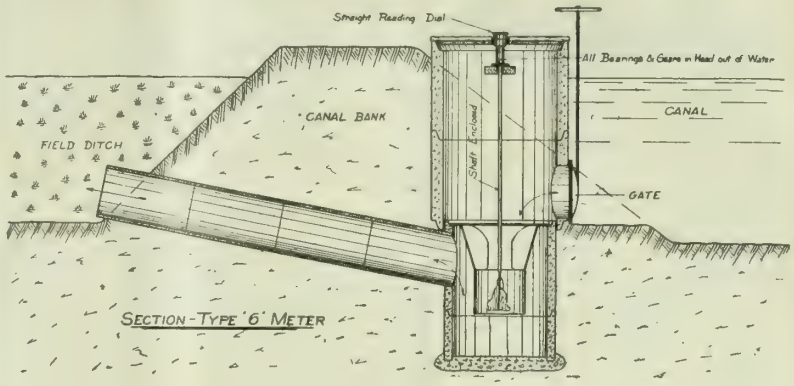

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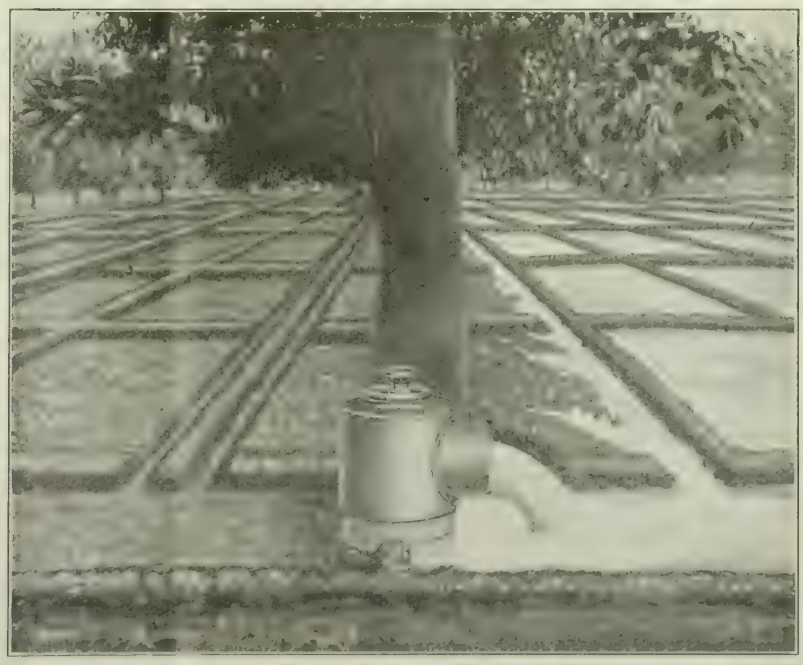

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T 2 N, R 3 E; Secs. 5, 6, 7, 8, T 1 N, R 4 E, and Sec. 31, T 2 N, R 4 E, for irrigation of 2464.6 acres near point of diversion.

Permit No. 2591, Application No. 4943 (San Joaquin County) Issued to Rindge Land Reclamation Dist. No. 2037, Stockton, Calif., August 12, 1926 for 85.45 cubic feet per second from San Joaquin River, Disappointment Slough, 12 Mile Slough and 14 Mile Slough, movable point of diversion in Secs. 1 & 12, T 2 N, R 4 E, and Secs. 5, 6, 7, 8, 9, 10, 11, 13, 14, 15, 16, 17, 18, 20, 21, 22, 23, 24, 26, 27, 28, 29, T 2 N, R 5 E, for irrigation of 6837.26 acres near point of diversion.

Permit No. 2592, Application No. 4944 (San Joaquin County) Issued to Rindge Land Reclamation Dist. No. 2038, Stockton Calif., August 12, 1926 for 71.74 cubic feet per second from Empire Cut, Whiskey Slough & Middle River in Secs. 1, 2, 3, 10, 11, 12, 13, 14, 15, 16, T 1 N, R 4 E and Secs. 5, 6, 7, 8, 9, 16, 17, 18, T 1 N, R 5 E, for irrigation of 5739 acres near point of diversion.

Permit No. 2593, Application No. 4945 (San Joaquin County) Issued to Rindge Land Reclamation Dist., No. 2039, Stockton, Calif., August 12, 1926 for 78.6 cubic feet per second from Trappers Slough and Middle River, movable points of diversion in Secs. 13, 14, 15, 16, 21, 22, 23, 24, 25, 26, 27, 35, 36, T 1 N, R 4 E, and Secs. 16, 17, 18, 19, 20, 21, 29, 30, T 1 N, R 5 E, for irrigation of 6289.1 acres near point of diversion.

Permit No. 2595, Application No. 5063 (San Joaquin County) Issued to Antonio Sanguinetti, Stockton, Calif., August 14, 1926 for 0.72 cubic foot per second from San Joaquin River in Sec. 5, T 1 S, R 6 E, for irrigation of 58.9 acres near point of diversion. Estimated cost $3,700.

Permit No. 2596, Application No. 4951 (Butte County) Issued to Herbert W. Barmann, Chico, Calif., August 16, 1926 for 10 cubic feet per second from Canal of Drainage Dist. No. 100 in Secs. 30 & 31, T 19 N, R 2 E, for irrigation of 1293 acres near point of diversion. Estimated cost $1000.

Permit No. 2601, Application No. 5018 (Trinity County) Issued to Viola A. Dailey, Burnt Ranch, Calif., August 25, 1926 for 1.25 cubic foot per second from Panther Creek in Sec. 12, T 6 N, R 6 E, H. M. for use for domestic and irrigation of 100 acres in Sec. 18, T 6 N, R 7 E. Estimated cost $3,000.

Permit No. 2602, Application No. 4911 (Butte County) Issued to Charles Bloom, Richvale, Calif., August 25, 1926 for 2.65 cubic feet per second from Ditch "B" of Drainage Dist. No. 200 in Sec. 22, T 19 N, R 2 E., for irrigation of 105.9 acres of rice near point of diversion. Estimated cost $1,000.

Permit No. 2603, Application No. 5064 (San Joaquin County) Issued to John H. Masters, Stockton, Calif., August 25, 1926, for 0.9 cubic foot per second from Burns Cutoff in Sec. 12, T 1 N, R 5 E, for irrigation of 72.4 acres in Sec. 14. Estimated cost $5,000.

Permit No. 2605, Application No. 3883 (San Bernardino County) Issued to Sheep Creek Water Company, Phelan, Calif., August 27, 1926 for 3000 acre feet per annum from Sheep Creek surface and subsurface flow in Secs. 9 & 10, T 3 N, R 7 W. for domestic and irrigation of 1920 acres near point of diversion. Estimated cost $150,000.

OREGON

Among the more important applications for permit to appropriate water filed in the office of Rhea Luper, State Engineer of Oregon, during August, 1926, were the following:

Frank C. McColloch, Trustee of Baker, covering the appropriation of water from Pine Creek for the construction of a reservoir for placer mining, at an estimated cost of $3,000.

Walter E. Hardy, of Portland, covering an appropriation of water from a tributary to Pacific Ocean, for auto camp purposes in Lincoln County.

Elmer E. Fletcher of Almira, Lane Co., covering an appropriation of water from Hannavan Creek and a canyon, tributary to Long Tom, for irrigation of 40 acres.

Harry J. Warner, of Portland, covering an appropriation of water from a stream tributary to Sandy River for domestic use, at an estimated cost of $350.

Edward W. Hartley, of Richland, Baker Co., covering an appropriation from waste water for irrigation from Eagle Creek, for supplemental irrigation, domestic and stock use, for forty acres.

Oregon State Highway Commission, covering an appropriation of water from several springs, tributary to Powder River. Not yet estimated.

J. H. Donaldson of 92nd St., Portland, covering an appropriation of water from Rock Creek (Clackamas River) for irrigation, power and fish propagation.

City of Milton, covering an appropriation of water from Walla Walla River, for power and municipal purposes.

Rainbow Mining Company of Rye Valley, Malheur County, covering an appropriation of water from two springs for mining and domestic purposes, at an estimated cost of $2500.

Omer Hastie, of Woodburn, covering an appropriation of water from Butte Creek, for irrigation of 15 acres, at an estimated cost of $250.

Amos Burns, of Mulino, covering an appropriation of water from Little Cedar Creek for irrigation of 10 acres, and domestic use, at an estimated cost of $300.

Virlin E. Brown of Tillamook, covering an appropriation from spring and creek for domestic use, at an estimated cost of $175.

M. P. J. & J. P. J. Barry of Lakeview, covering an appropriation of water from spring for stock use.

The Oregon State Game Commission, covering an appropriation of water from Oak Spring, for trout hatchery and feeding ponds, at an estimated cost of $500.

The American Natl. Bank & Henry C. Judd of Pendleton, covering an appropriation of water from Sutter Creek and flood water, for irrigation of 60 acres, at an estimated cost of $300.

Louisa Segui, of Rte. 3, The Dalles, covering an appropriation of water from a spring, tributary of Mill Creek, for domestic use and irrigation of 2 acres.

George A. Martin of Riverton, Coos Co., covering an appropriation of water from creek trib. to Coquille River, for domestic supplies, at an estimated cost of $500.

D. N. Cotton, of Myrtle Point, covering an appropriation of water from two springs, for domestic use, at an estimated cost of $150.

Ernest and Pansy Applegate and J. L. Grubb Estate, of Ashland, for the construction of a reservoir, for the waters of Ice House Creek.

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Legal and Judicial

(*Continued from Page 44*)

Supreme Court Rules on Appropriation of Spring Water

Waters of a spring flowing down a well defined stream are subject to appropriation.

In the case of Allison v. Linn, 247 Pac. Rep. 730 (Wash. July 8th, 1926) the Supreme Court of Washington reverses a finding of the trial court concerning the appropriation of water from a spring.

The trial court stated in its opinion: "My conclusion is that there is not a flowing stream. It does not lead to anywhere. . . . . A small stream of water from the spring comes over onto the land of appellant for a certain distance . . . and seeps away into the ground at that point . . . . I think a flowing stream must flow on down to a certain place and have a mouth somewhere. . . . . ."

The Supreme Court in answer to the remarks of the trial court says:

We are afraid the learned trial court was guided too much by what he saw at the dry season of the year, and was temporarily misled by the idea that in order for there to be a stream in a legal sense it must flow on down to a certain place and have a mouth somewhere. But even if we take its view of the flow, it would seem that at the time he visited the premises there was a well defined stream for about 200 feet in appellant's lands. The fact, if it be such, that the waters then disappeared into the ground, or that there was no mouth to the stream, as suggested by the court, ought, it seems to us, make no difference . . . . All . . . these facts, together with what the court found by a view of the spring, would seem to require a holding that there was a well defined stream running upon and over at least a portion of appellant's land. . . . ."

Supreme Court Rules on Springer Ditch Co. Case

Owner of a reservoir is required to use ordinary care in inspecting and maintaining a dam.

In the case of Springer Ditch Co. v. Wright, 247 Pac. 270, the Supreme Court of New Mexico holds that the case being based upon the question of negligence in inspecting and maintaining a dam and the court finding such negligence, the question of the rule of liability applicable to one who stores waters for irrigation, and as to whether the doctrine of res ipsa loquitur may be invoked cannot be considered by the Supreme Court.

The Supreme Court stated:

"Rulings excluding, as mere offers of settlement, evidence relied upon as admissions were considered in two recent decisions of the court. . . . . It is quite apparent that the exclusion of the conversation was warranted under these decisions. We think also that the exclusion of the writing must be sustained. . . . ."

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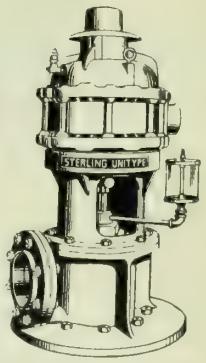

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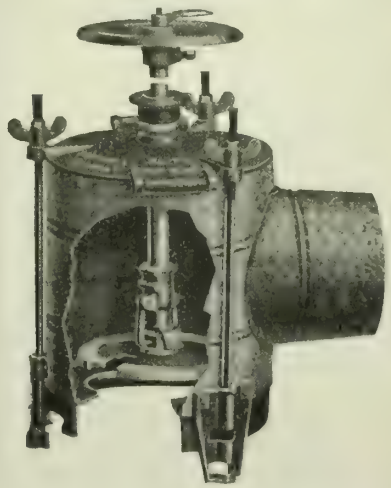

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AMONG OUR CONTRIBUTORS

Editorial Jottings About Current and Forthcoming Feature Articles, Dealing With Practical Problems of Hydraulics, and the Men Who Have Written Them

THE COLLEGE PROFESSOR holds the most prominent place in this issue of MODERN IRRIGATION, and he shows himself not the visionary, absent-minded fellow he is represented to be in the humor columns and sometimes in literature, but rather the alert, practical man ready and able to cope with the perplexities that meet the irrigators in their work.

S. H. Beckett, author of "Anticipating the Problems of Tomorrow's Irrigators," is Associate Professor of Irrigation Investigations and Practice, College of Agriculture, University of California. He is a former member of the U. S. Reclamation Service and just prior to his association with the university, was identified with the Department of Agriculture. Professor Beckett keeps in unusually close touch with the irrigators of the west and is especially fitted to write of their needs. His article is the first that MODERN IRRIGATION is presenting to give its readers an outline of what the western colleges are doing for the industry.

W. L. POWERS, who writes the article on feasibility surveys in connection with irrigation projects, is no stranger to the readers of MODERN IRRIGATION. Not only has he been presented as one of the advisors of the journal, but he also contributed last fall a very able article on "A Constructive Irrigation Program for Oregon." Professor Powers is Chief of the Division of Soils at the Oregon State Agricultural College. He has been an active member of the Oregon Reclamation Congress since its beginning in 1910 and is at present its secretary. He has also been secretary of the Oregon State Drainage Association since its formation ten years ago.

H. E. ERDMAN, who discusses the question of farm tenancy, is a member of the faculty of the College of Agriculture, University of California, in the department of Agricultural Economics. He is a graduate of the South Dakota College of Agriculture and Mechanical Arts, and has a Ph. D. degree from the University of Wisconsin. From 1912 to 1914 he was deputy state dairy expert in South Dakota. In 1917 he went to the Ohio State University as Assistant Professor of Rural Economics. He remained there until 1922, and during part of this time, in addition to his teaching, had charge of the Costs of Marketing Division of the Bureau of Markets and Crop Estimates, a bureau of the U. S. Department of Agriculture. In 1922 he came to the University of California as Associate Professor of Rural Institutions and was appointed to his present position there as Professor of Agricultural Economics during this year. Professor Erdman was one of the lecturers at the first session of the American Institute of Co-operation, held during July and August, 1925.

F. W. SLATTERY, who tells of some of the problems encountered in the drainage of the Imperial Valley, is the engineer in charge of the very extensive drainage operations there. MODERN IRRIGATION hopes to have an account of other phases of Mr. Slattery's work in some future issue of the journal.

RAYMOND A. HILL graduated from the University of Michigan in 1914 with the degree of Bachelor of Civil Engineering, and was given the degree of Civil Engineer in the same university in 1922.

From 1909 until 1917, except while at the university, he was with the U. S. Reclamation Service in various capacities including surveys, design, special investigations, and supervision of construction of irrigation works in Colorado, Utah and Arizona.

From May, 1917, to August, 1919, he served in the United States and France as an engineer officer in the United States Army.

Since 1917 he has been associated with Quinton, Code and Hill, Consulting Engineers of Los Angeles, and has been engaged principally upon various irrigation projects in the Southwest and Mexico. During the last year he made a detailed investigation of the irrigation requirements and the economic feasibility of the project on the Rio Mayo in Sonora, Mexico, which has been fathered by Ex-President Obregon, and upon which the Federal Government anticipates spending about $10,000,000 in accordance with its program of irrigation development. In connection with this work, Mr. Hill was thrown in close contact with the members and engineers of the Comision Nacional de Irrigacion of Mexico, and had the opportunity to have several conferences with President Calles.

Mr. Hill is a member of the American Society of Civil Engineers and is president of the Los Angeles section of the society.

JAMES GRAVES SCRUGHAM is more popularly know as the "engineer governor" of Nevada. He received his B. M. E. from the University of Kentucky in 1900, finishing with his M. E. in 1906. He then went into the professional engineering field with a group of three different organizations. From 1903 till 1914 he was professor of mechanical engineering at the University of Nevada. Since 1914 he has been the dean of the Engineering College of the University of Nevada. In 1917 he became state engineer of Nevada, and in 1919 he was made Public Service Commissioner. During the war he served as chief of carriage section, production and artillery divisions of the Ordinance department in 1918. That he has had a wide range of experience in public affairs is further shown by the fact that he served on boards of the San Francisco and San Diego expositions of 1915. In 1916 he was made an associate member of the U. S. Naval Consulting Board. The American Legion made him national vice-commander for 1920-21. Since his election to the governorship of Nevada he has given his time to bring Nevada from a state that people used to dread to cross to a veritable land of comforts through his engineering knowledge and application.

THIS MONTH'S COVER has a particular appeal to the waterworks engineer. The photograph shows the Soledad siphon section of the Los Angeles aqueduct. Countless difficulties were encountered in laying this giant pipe line and engineering problems apparently insurmountable were solved. MODERN IRRIGATION is indebted to the U. S. Electrical Manufacturing Company, Los Angeles, for this illustration.

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For 12 Months: $2.00; Single Copies: 20 cents.

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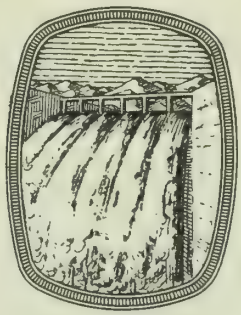
C. B. JACKSON

Chairman of the California Section of the American Water Works Association, which is holding its seventh annual convention at San Diego October 28, 29 and 30. Mr. Jackson has for many years been general manager of the Fresno City Water Corporation, which was recently purchased, with the Chico Water Supply Company, Bakersfield Water Supply Company and Visalia Water Supply Company, all of California, by the Federal Water Service Corporation of New York. Mr. Jackson was elected vice president and general manager of the combined properties in October.

MODERN Irrigation
The Magazine of Applied Hydraulics



Volume II OCTOBER, 1926 Number 10

Our Debt to Water Works

WHILE the function of this department of the magazine is, as its usual monthly title line indicates, to report the "progress of irrigation," it seems fitting that no little space in this issue should be devoted to a discussion of the progress of *water works*. As a matter of fact, development in the two fields is, to a large extent, interrelated in the west, as pointed out on another page of this issue; and whether the subject matter be water works or irrigation and reclamation the story should be of interest to nearly all readers of the magazine.

Climaxing seven years of co-ordinated effort and co-operation in all matters affecting water works development, the California Section of the American Water Works Association is meeting at San Diego in annual convention Oct. 28, 29 and 30. That the purposes of the association have been and are being accomplished, in large measure, insofar as the Pacific Coast is concerned, will be evident to those who attend the convention and follow its program closely; for that program will constitute a symposium of western water works progress during the current and preceding years.

A glance backward is necessary to visualize in proper perspective the development of water works in this country. Until 1870 there were no water filtration plants in the United States as the term is now understood, although some of the surface supplies then in use were passed through so-called filters or strainers of gravel, charcoal or sponge. Bridging fifty-five years of progress and reviewing developments of the last year, one learns that there were about 587 rapid and about 47 slow sand filters in use, with a total capacity of approximately 5,000 million gallons a day.

Chlorination dates from 1908. It is now used on nearly all surface supplies, whether filtered or not. Credit for the first systematic use of chlorine for treatment of a large supply of water is due to Sir Alexander Houston when, in 1904 and 1905, a dosage of one part per million of chlorine was applied in the form of sodium hypochlorite. In 1913 apparatus for applying liquid chlorine from cylinders had been perfected and put on the market. In 1924 over 3,750,000,000 gallons per day were being treated in more than three thousand cities and towns in the United States. There are now 6,000 installations of chlorinating equipment in use in the country and it is estimated

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that 70 per cent of the population of North America are drinking water treated with liquid chlorine.

The great service to mankind involved in this development is of course well known to the water works and sanitary engineers. The large reduction in typhoid fever in the United States has been largely due to the measures for safeguarding domestic water supplies described in the foregoing paragraphs. To the introduction of new water supplies and the improvement of both old and new systems by means of sanitary protection, filtration and chlorination the heavy reduction —and in many places the virtual disappearance— of typhoid fever is largely due. It is well to recall that no longer than 30 years ago typhoid death rates of 20 to 100 per 100,000 were common with rates in bad years in the most afflicted cities running higher.

The visitor at the San Diego convention of the California Section of the American Water Works Association will not only be impressed with the way in which the water works have made good with mankind in lessening the death rate of urban communities, but he will—if his experience in the profession dates back many years—be impressed with the purely physical development of water works; as, for instance, the development in pumping equipment, the wonders that research on pipe protection has wrought, the development of the water meter and other accessories to the modern water supply system. A panorama of this kind of development will unfold before the visitor to the exhibits of manufacturers. These will form an important educational adjunct to the convention.

Waterworks officials find that a part of the value of attendance at the annual meetings comes from this exhibition of waterworks equipment and supplies. It is an old feature with the parent organization and is of such demonstrated usefulness to the buyer and maker alike that an ernest endeavor, helped by long experience, results annually in an exhibit surprising to those who see for the first time, brought together in one place, the industrial products now available for waterworks plants.

Without doubt the American Water Works Association performs a real service for the most important public utility business in America. The demand for water is growing even faster than the increase in the population of the country would indicate, because a steadily increasing proportion of the population is living in communities served by waterworks and with more industries and better living conditions the consumption per consumer is mounting continuously. The association is serving a big purpose in meeting the demands of this growth "through the advancement of knowledge of the design, construction, operation and management of waterworks, and the encouragement by social intercourse among its members of a friendly exchange of information and experience.

One of the biggest consolidations of recent years affecting California water companies was announced at press time. Reports from New York City state that for an estimated consideration of $3,500,000 the Federal Water Service Corporation has acquired the Fresno Water Corporation, Chico Water Supply Company, Bakersfield Water Supply Company, and the Visalia Water Supply Company.

These four water companies were actively connected with the pioneer struggles of these San Joaquin Valley cities in their development from the plains. The largest company of the four is the Fresno City Water Corporation, formerly a part of the Western Power System, and the consideration for the transfer of this property alone was said to be $2,500,000.

WESTERN WATERWORKS

IS HERE

WITH this issue MODERN IRRIGATION introduces the new publication WESTERN WATERWORKS—a magazine within a magazine—devoted solely to the interests of the waterworks industry of the west. It will appear, for the time being, as a supplement to MODERN IRRIGATION.

Turn to Page Thirty-three

See Page 33 for First Issue of "Western Waterworks"

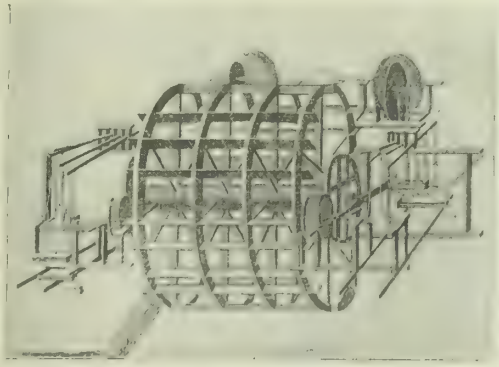
Water works under the Ancient London Bridge, 1588, from an old print

Looking Backward

Over 344 Years of Waterworks History

IN 1852, Peter Morris, a free citizen of Holland, went to London and designed and built a water works which was put under the arches of Old London Bridge which at that time was a roadway with houses built on each side like a city street. This water works was operated by undershot water wheels that drove four pump cylinders from each end of the wheels. The design has come down to us in its original form as shown in the illustration copied from the original copper plate. The exact specifications to which the pump cylinders were made have been hidden by the dust of the intervening years.

This water works pumped water from the Thames through pipes of lead and supplied various houses in the ancient city. It required, however, four more relay pumps worked by horses to supply the outlying districts. This works was enlarged from time to time until it became, by successive improvements, a unique and truly ingenious and powerful piece of mechanism—wonderful for that age. The city of London was chiefly supplied with water by this works for a long period of time, until it was removed by Act of Parliament in 1822.



Water wheel of the London Water Works

A Snowball Growth

THERE has been a tremendous effect produced by the development of water works systems, and a glance backward will show how comparatively rapid this development has been. At the close of 1800 there were seventeen waterworks in the United States; this doubled to 34 in 1825 and there were 100 in 1850. This had increased to 243 in 1875, after which there was a very rapid growth and 1000 waterworks were recorded in 1885. In the next ten years this had tripled and by 1925 over 10,000 water works were registered. The accompanying illustrated article, secured through the courtesy and co-operation of "Oil-Power," published by the Standard Oil Company of New York, gives briefly some of the outstanding events in early water works development. The reader will be impressed with and feel grateful for the early work of the men who not only developed this art, but who worked on the early steam engines and in the machine shops in which these aids to civilization were produced.

First Water Works in America

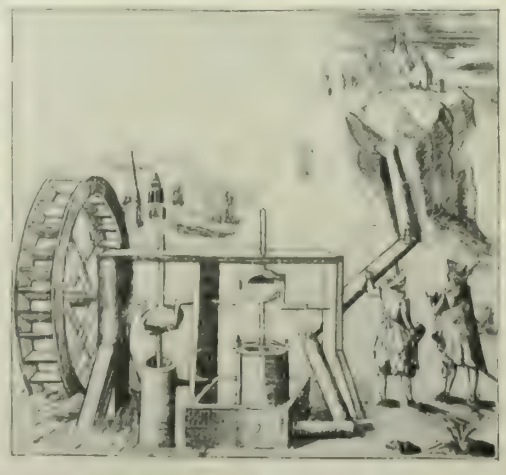
The early settlers who founded Bethlehem, Pa., in 1741, selected a site near a sparkling spring to insure a convenient and abundant supply of pure cool water. When the first log cabins were built each family supplied itself by hand with its water requirements, but later, as the settlement grew, the water distribution was organized and individual needs were distributed to the log cabins of the community by water carriers or haulers formally delegated for the purpose, one of whom, history relates, in the faithful discharge of his duties had the mishap to upset his cart and fracture his arm.

In 1751, a new settler arrived by the name of Hans Christopher Christiansen, a millwright by profession and by nature a mechanical genius. In 1754, due to the inventive ability of this young Dane, he was given the job of supplying the community with water otherwise than by manual distribution. A building 19x22 feet was built to house a pump made of lignum-vitae with a cylinder 5 inches in diameter. This pump was driven by an undershot water wheel. The water supply was forced through pipes up a hill to a reservoir. The pipes were hemlock logs with a hole bored through them.

When the pump was first started water was thrown over the adjoining houses much to the wonder and admiration of the members of the community and of visitors who came for the occasion. Many interruptions in the service were caused by bursting wooden pipes, and to overcome this difficulty a 1½-inch lead pipe was made of sheet metal, soldered along the edges and imbedded in a cement of pitch and brick dust and all laid in a gutter of burnt brick.

Improves on Original

Christiansen commenced a second and



Undershot water wheel working two stage force pump for supplying water to a town. From Zeising, 1607.

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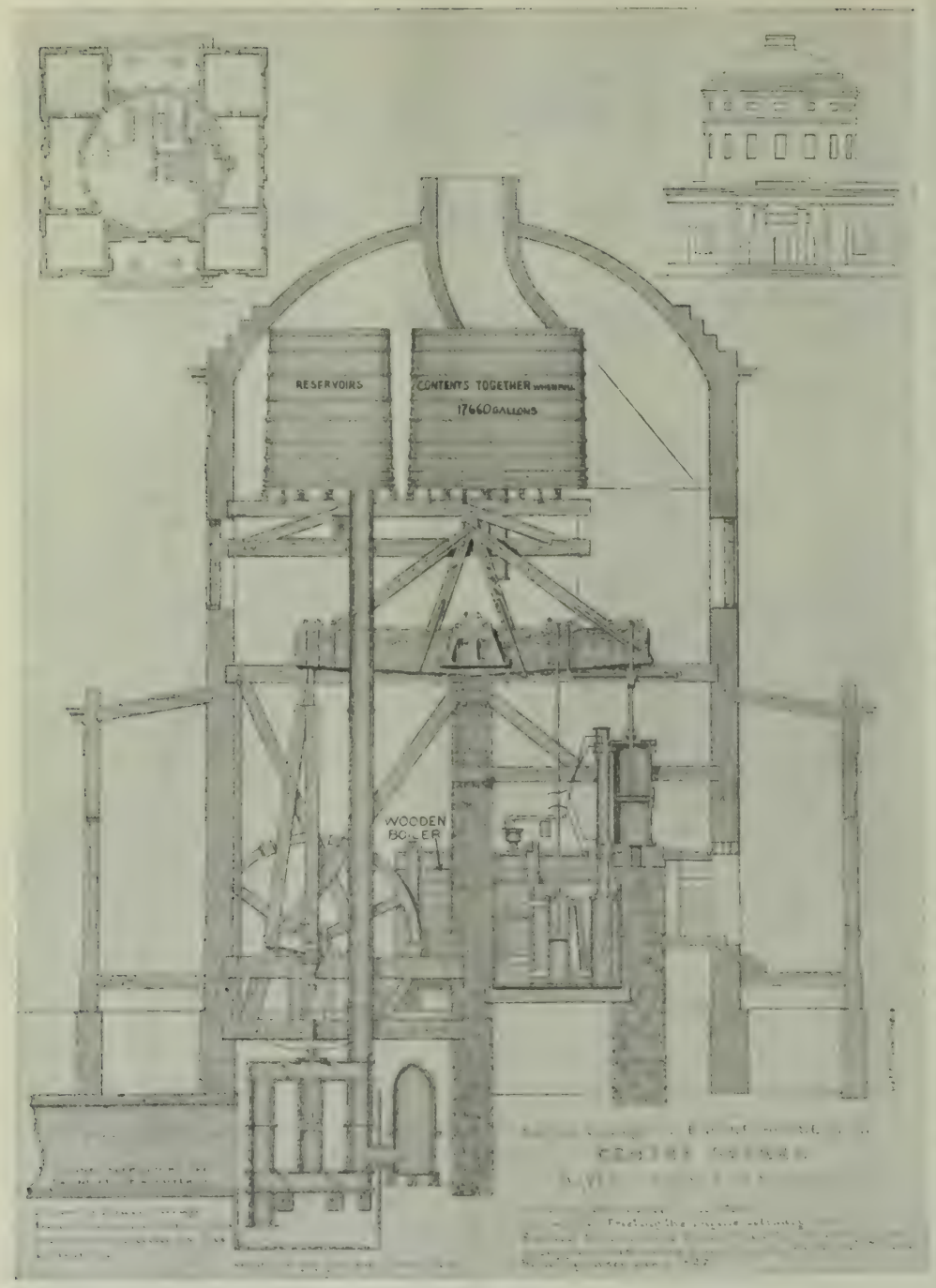


Plan of the Centre Square Water Works, Philadelphia, 1799. From the Transactions of the Franklin Institute, Philadelphia, Vol. 25, 1853

more powerful pump in 1761. This consisted of three single acting force pumps of iron 4-inch "caliber" and 18-inch stroke worked by a triple crank which was forged by the resident blacksmith, Stephen Blum. This triple throw shaft was ever the just subject of pride as to ingenuity of workmanship. The undershot water wheel was 18 feet in diameter and 2 feet clear in the buckets.

On the water wheel shaft was a "wallower of 33 rounds" which geared into a spur wheel of 52 cogs attached to the crankshaft of the triple pump. The crossheads were made of wood and worked in a vertical grooved wooden frame. This pump could force water 112 feet and it supplied water to 7 reservoirs placed at strategic places around the little town, such as in front of the Widow's house, in front of the Sun Tavern, at the apothecary's, at the stable and hattery in the rear.

Thus was maintained a very complete system of water delivery in Bethlehem during the early days of the Republic which impressed visitors with astonishment and admiration. This first pumping station was visited by the Governor of the State, by the Governor of South Carolina, by the Governor-General of the Danish West Indies, by John Adams, General Washington and many other distinguished men of the day.

Iron pipes were introduced in 1813. In 1832 the triple pumps after a service of 70 years were supplanted by a double acting pump of large dimensions, being 5-inch caliber and 36-inch stroke, and this in turn was replaced by a steam pump in 1868.

Water Works of New York

During the days of the Indians and the first Dutch settlers in Manhattan fresh water was secured from numerous springs, ponds and brooks on the island and from shallow wells by means of buckets raised by ropes or pulleys, or by long balanced poles. The water thus secured was pure except near the shores of the island where salt water percolated through, rendering it unfit for cooking and drinking purposes. As the colony grew, public wells were sunk in the middle of the most important streets, the first well being sunk about 1658.

In 1731 when the town consisted of 1,200 houses and 8,628 people, the Council purchased its first fire engine from England, two of them being ordered. This raised the important question of adequate water supply in order to meet the demands of these engines for fire fighting purposes and this led to sinking an additional number of wells to furnish water for domestic purposes and also for use in case of fire.

The primitive buckets at the wells were gradually replaced by pumps. One of the most famous of these was known as the "Old Tea Water Pump," first mentioned in 1748. This pump was placed over a spring of pure water and the surroundings became famous as a resort where tea and

Bored logs which carried Manhattan water

See Page 33 for First Issue of "Western Waterworks"

stronger beverages could be obtained.

New Water Works Proposed

In 1774 a proposal for constructing a water works was made to the Common Council; Christopher Colles, an English engineer drew plans for a reservoir into which water was to be pumped from wells by means of a steam engine, the water to be then distributed by pipes leading along the main street. The Common Council accepted this proposal. Some property at the corner of Broadway between Pearl and White Streets was set aside. A large well was sunk and a Newcomen engine was ordered from England.

This works was put in operation in 1776 at the opening of the Revolutionary War. The plant, however, was not large enough to supply the needs of the town—war demoralized everything and the entire enterprise was abandoned. After this early attempt several other proposals were made from time to time, but it was not until an epidemic of yellow fever forced the question of an adequate water supply that it was practically handled by the Manhattan Company, who secured a charter in 1799 to supply the City of New York with pure and wholesome water.

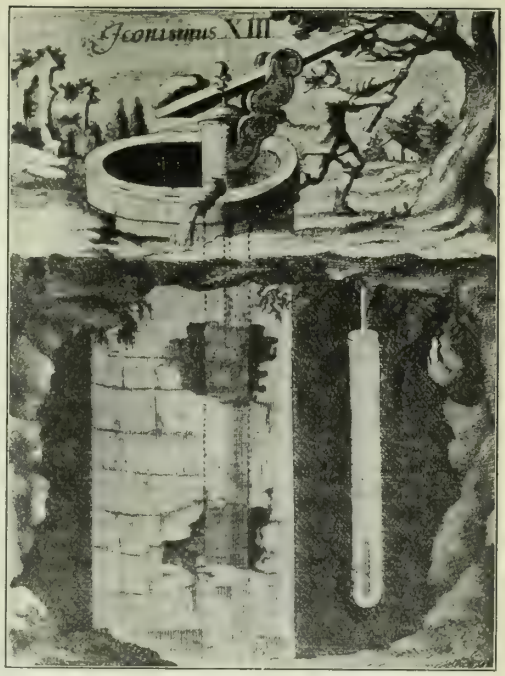
Steam Engine Rejected

The minute book of the Manhattan Company, which is now a valued relic in the possession of the Bank of the Manhattan Company of New York, shows the daily progress of putting in a water supply for the town. A survey of the Bronx was made to see if there was any possibility of bringing water from that source, which might also turn the water wheels to operate the force pumps. This project was not considered practical. On April 17, 1779, the minutes state that information was secured through an authorized source from Bolton and Watt showing the amount of water that could be pumped by various sizes of steam engines and further that an engine sufficient for the needs of the town could be purchased for $12,000.

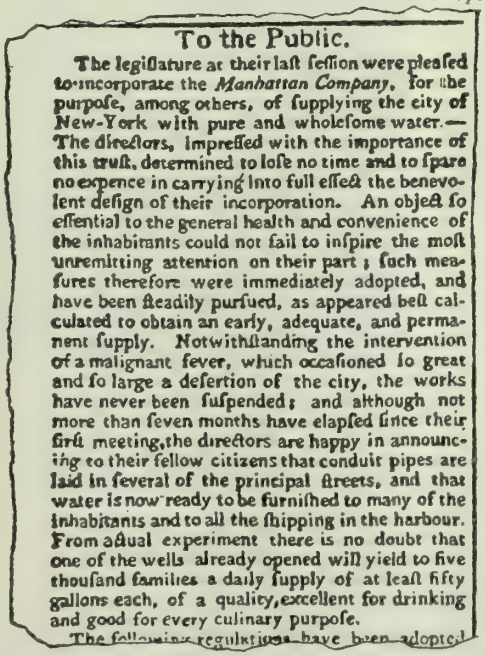
On June 10th of the same year the Board considered an offer made by Nicholas Roosevelt to purchase a steam engine. Nicholas Roosevelt at that time had built an engine from a model of Hornblower's atmospheric engine and had built steam engines for various other purposes. The offer for this engine was not accepted by the Board although Roosevelt undertook to operate his engine for a period of time.

On June 17th of the same year the Board authorized that horses be used to work the pumps. These pumps were later placed in a house 12 feet square fronting on Cross Street on the corner of Little Ann and Reade Streets; eight horses were purchased and a plant was put in operation during 1800 at which time New York had a population of 56,000 people. Water was delivered to houses of subscribers through wooden pipes used as mains to which were connected lead pipes that ran into the individual houses. The water rate for each house was $5.00 per year for each fireplace in the house. Vessels in the harbor were supplied at 20 cents per hogshead.

After this horse operated plant had been in use for some months John Stevens offered to erect and maintain a steam engine in the house then occupied by the horse operated pumps. His proposition was accepted, the minutes specifically stating that the engine was on trial and could be removed at any time, and that the company was not obligated to purchase. This engine operated a pump that handled one-half million gallons in 24 hours. The engine having proven acceptable, the Board of Directors purchased it for $6,000. Six months' expense in operating this engine is shown by the following bill:



Hand operated water pump. From P. Gasparis Schotti, 1657



To the Public.

The legiſlature at their laſt ſeſſion were pleaſed to incorporate the *Manhattan Company*, for the purpoſe, among others, of ſupplying the city of New-York with pure and wholeſome water.—The directors, impreſſed with the importance of this truſt, determined to loſe no time and to ſpare no expence in carrying into full effect the benevolent deſign of their incorporation. An object ſo eſſential to the general health and convenience of the inhabitants could not fail to inſpire the moſt unremitting attention on their part; ſuch meaſures therefore were immediately adopted, and have been ſteadily purſued, as appeared beſt calculated to obtain an early, adequate, and permanent ſupply. Notwithſtanding the intervention of a malignant fever, which occaſioned ſo great and ſo large a deſertion of the city, the works have never been ſuſpended; and although not more than ſeven months have elapſed ſince their firſt meeting, the directors are happy in announcing to their fellow citizens that conduit pipes are laid in ſeveral of the principal ſtreets, and that water is now ready to be furniſhed to many of the inhabitants and to all the ſhipping in the harbour. From actual experiment there is no doubt that one of the wells already opened will yield to five thouſand families a daily ſupply of at leaſt fifty gallons each, of a quality, excellent for drinking and good for every culinary purpoſe.

The following regulations have been adopted

Newspaper notice of formation, about April, 1799, of the Manhattan Company (predecessor of the Bank of the Manhattan Company) to supply water service to New York City.

May 1st to Nov. 1st, 1802	
Coal and carting, etc., (supposed sufficient for nine months)	$2,888.39
Attending to engine	823.70
Blacksmith's bill for repairs of horse pumps, pumps, engine, etc.	129.29
Tallow, spun yarn, leather, candles, etc.	143.28
Making a total of	$3,983.66

Used Tallow Lubricant

This last item is of particular interest as it includes the tallow lubricant for the engine. The spun yarn was used for packing the joints of the pipes and possibly also for stuffing box glands. Leather could have been used for repairing the harness and could also have been used for packing the steam piston as well as water plunger, a method in use in the early days of James Watt.

The first chief engineer of the Philadelphia Water Works reported this information: "This New York Water Works engine has been built upon the principle of Bolton and Watts double engine without any variation. It has

(*Continued on Page 78*)

Groton Fountain, Bowling Green, about 1842

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G. A. ELLIOTT
First chairman of the California Section of the American Water Works Association. Mr. Elliott served two terms.

Irrigation and *Waterworks*

Go Hand in Hand in the Forward March of Civilization

An Article About the "California Section"

By HINDA TEAGUE HILL

WATER, and still more water, has been the ever-increasing demand that has marked the first quarter of the twentieth century. Farm lands and cities alike call for water. With the passage of the National Reclamation Act, in 1902, the government undertook the development of projects not feasible by private, corporate, district or state enterprise, leaving to these smaller organizations the projects within their financial reach.

Just as the irrigation projects have reclaimed desert lands and have made homes possible in sections hitherto given over to the snake and coyote, so the water works companies have made living easier for the inhabitants of towns and cities. The smaller towns have recognized the fact that they cannot attract larger populations except as they are prepared to furnish water for them. The cities have realized that water mains must be extended to new sections, that existing mains must be replaced by larger ones. According to figures given by the American Water Works Association in 1925, water works investments in the United States are now increasing at the rate of $100,000,000 to $125,000,000 or more a year.

In this great increase the western states have a large share. For the state of California, and to a certain extent for neighboring states, one of the most important factors in recent growth has been the California Section of the American Water Works Association.

S. B. MORRIS
Vice-chairman for 1926 of the California Section, American Water Works Association. Mr. Morris served as secretary and treasurer of the section during 1925.

The American Water Works Association, which had been founded in 1881 and was a flourishing institution, had a gradually growing membership in California—enthusiastic men who felt the need of a state organization as a section of the parent association. They realized what was taking place about them and they had a vision of the future. They wanted an opportunity to meet together, to become acquainted, and to talk over their problems to see if by chance the other fellow had found a solution.

One of the men most closely associated with the present California Section, and perhaps the outstanding figure in its organization and development, a man who for the first six years was a member of its executive board in one capacity or another, is George W. Pracy, now Superintendent of the Spring Valley Water Company, San Francisco. In 1915, while discussing a water problem with two of his associates, he brought up the question of a California section of the American Water Works Association. Shortly after, he learned that still another member of the association, Kenneth Shibley, had the same idea and was waiting for an opportune moment to put it into effect.

During the year these men talked with other available members of the association and found that they were unanimous in their desire to call a meeting and organize a California section. The plan was cut short by the entrance of America into the World War. The matter was dropped for the moment and the organizers all turned their energies to the needs of the country.

First Meeting in 1919

In 1919 the war had come to an end and the leaders of the west were again looking to the development of a great program for their land. It was in that year that all members of the American

PAUL E. MAGERSTADT
The present secretary and treasurer of the California Section, American Water Works Association.

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Water Works Association in the vicinity of San Francisco Bay were called to a preliminary meeting held in San Francisco, and the California Section became a reality. By-laws were drawn up and officers were elected. G. A. Elliott, vice president and chief engineer of the Spring Valley Water Company, San Francisco, was elected the first chairman; Charles Gilman Hyde, professor of Sanitary Engineering, University of California, was made vice-chairman; and George W. Pracy was elected secretary-treasurer.

The first annual convention of the California Section of the American Water Works Association was held in San Francisco, November 13, 1920, with seventy-five present from all parts of the state. It was a one-day session. At the morning meeting E. P. McMurtry, chief engineer of the Krogh Pump and Machinery Company, read a paper on "The Centrifugal Pump;" Ralph Hilscher, of the California State Board of Health, discussed "Chlorination in California;' and O. E. Clemens, water sales manager of the Spring Valley Water Company, presented some very practical ideas on the "Business End of Water Works."

Luncheon was served at the Engineers' Club, and in the afternoon the delegates inspected the properties of the Spring Valley Water Company. At the evening session M. M. O'Shaughnessy, city engineer of San Francisco, discussed the formation of the Marin Municipal Water District, a combination of some twelve towns, united to provide themselves with a domestic water supply. The officers elected for the following year were: Chairman, G. A. Elliott; Vice-Chairman, L. M. Anderson, Comptroller, Public Service Commissoin; Secretary-Treasurer, George W. Pracy.

Los Angeles Host in 1921

Los Angeles entertained the California Section at its second annual convention, October 1 and 2, 1921. Seventy-two were present from all parts of the state. R. E. Andrews, assistant chief engineer, National Board of Fire Underwriters, read a paper on "Fire Protection." "Causes and Prevention of Electrolysis Troubles in Underground Pipe Systems," was the subject of a paper prepared by E. B. Stewart, and read by H. Reinhardt, assistant chief engineer of the East Bay Water Company, Oakland. George Read, superintendent of the Service and Meter Department, Los Angeles, discussed "Water Meters." Then followed a helpful general discussion of water works problems in which a great number of the delegates took part.

In the evening the delegates were entertained at a dinner served at the City Club of Los Angeles, after which William Mulholland, chief engineer of the Los Angeles Bureau of Water Works and Supply, spoke on the "Los Angeles Water Supply." Saturday, the 2nd, was given over to a trip to points of interest in the Los Angeles water system, and luncheon was served in the construction camp at the San Fernando dam. The officers in charge were re-elected, and C. G. Gillespie and F. N. Isaacs were added to the executive committee.

For its third annual session the California Section met with the East Bay Water Company, Oakland, California, on October 26, 27, and 28, 1922, with an increased attendance of 142 "members and guests" registered from all parts of the state. For the first time there was a three-day session, and for the first time, too, the manufacturers, who form the associate membership of the Section,

P. DIEDERICH
Member of the executive Committee, California Section, American Water Works Association.

staged an exhibit of their products. This exhibit has become one of the important features of the conventions in that it has an unusual educational value. The manufacturers have made a point of showing the very latest improvements along all lines, and not only have their equipment there for inspection, but give a demonstration of its application.

The additional sessions in 1922 gave an opportunity for a more varied program and in all eight pepers were presented. Edward F. O'Day, director of publicity, Spring Valley Water Company, discussed "Publicity"; P. W. Stamps, president of the Purchasing Agents Association of Northern California, gave many pointers on "Purchasing"; and Chester Loveland, consulting

JOHN BURT
Member of the executive committee, California Section, American Water Works Association.

engineer, read a paper on "Valuations and Rates."

"Pumping Machinery" was presented by B. R. Vanleer, assistant professor of Mechanical Engineering, University of California, and Charles H. Lee, consulting Engineer, San Francisco, spoke of "Underground Waters." W. F. Langelier, associate professor of Sanitary Engineering, University of California, described the "East Bay Filter Plant"; Charles Gilman Hyde discussed "Standards of Water Bacteria," and C. A. Kofoid, professor of Zoology, University of California, read a paper on "Microscopic Animalculae."

Besides the program there were many delightful entertainment features. The officers elected for the following year were: Chairman, L. M. Anderson, Comptroller, Public Service Commission; Vice-Chairman, Fred J. Klaus, assistant chief engineer, East Bay Water Company; Secretary-Treasurer, S. B. Morris, superintendent and chief engineer, water department, Pasadena; Executive Committee, C. B. Jackson, superintendent, Fresno City Water Corporation, Fresno, and George W. Pracy.

Fresno Gets the Convention

At the fourth annual convention the Association was the guest of the Fresno City Water Corporation, meeting in the American Legion Hall, Fresno, on October 25, 26, and 27, 1923. One hundred and forty-three members and guests registered. The program committee had prepared an even greater variety of subjects for papers and discussions. Ed-

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In the Delta County of the Sacramento River. Here water means transportation, irrigation, and protection against the encroaching tides of the sea. This region is famed for its production of fruits and vegetables. Shipping on the waterways of the delta in 1925 was valued at $127,693,000. With water playing so dominant a part in the economic scheme of things, it is no wonder that problems of the sort presented in this article are occupying the forefront of attention among water users along these streams.

Not Half Enough Water, Where Water is *Everything!*—Two Rivers' Epic Problem

By HARLOWE M. STAFFORD

Nothing theoretical or academic about this article! —written for MODERN IRRIGATION *by Water Supervisor Stafford as one of a series being published to show what the California Division of Water Rights is doing for irrigation in the leading irrigation state. In it he has shown how the water users of these two rivers are waging an epochal battle against the lowering water. An intensely interesting document from a human standpoint, it is a revealing description as well of how the State is aiding the water users to work out their problems.*

APPROPRIATIVE and other vested water rights on the Sacramento River between the city of Sacramento and Red Bluff, California, total 6000 second-feet. Water requirements both for irrigation and salinity control in the great and fertile delta of the Sacramento and San Joaquin Rivers, amount to 3500 second-feet or more. An estimated flow of from 3000 to 3500 second-feet in the Sacramento River above Sacramento is needed merely to satisfy navigation requirements. Yet there was an actual available flow in the river at Red Bluff of only 3000 to 3500 second-feet after July first in four of the last seven seasons and a summer flow of the San Joaquin River to the delta of less than 1000 second-feet! This, briefly, tells the story of the Sacramento-San Joaquin water problems.

At this writing, (early autumn in the 1926 season) there is an irrigation draft of close to 4000 second-feet between Red Bluff and Sacramento. With only 3000 second-feet at Red Bluff the excess demands are met by a combined inflow of 500 second-feet from the Feather and American Rivers and a return water inflow sufficient in amount that there still remains about 1300 second-feet passing the city of Sacramento. Navigation in the upper river is greatly impaired and salt water from San Francisco Bay is rapidly encroaching into the delta channels.

These problems are serious and are demanding earnest thought and endeavor from the various interests involved and from the State, for an early solution. The first acute situation to arise was that in 1920. In that year, with the run-off of the San Francisco Bay drainage area only 48 per cent of normal and the largest rice planting in the Sacramento Valley in the history of the industry, the situation was saved through the Emergency Water Conservation Conference, a voluntary organization of water users and state officials, and a Water Master appointed by the conference to regulate the Sacramento River diversions of those signing a Water Users' Agreement prepared by the conference. It was in this year, however, that, as a result of the salinity encroachment in the delta, the famous Antioch suit was instituted. This cost the valley some hundred of thousands of dollars but did not result in a solution or even a basis for a solution of the problem.

1924 Sees Emergency

Following years of more normal stream flow in 1921, 1922 and 1923 came the extremely dry year of 1924, when the

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run-off of the San Francisco Bay drainage was 27 per cent of normal. With the probability for a critical season evident as early as January in that year, a pressure for the initiation of a definite constructive program in the solution of the problems was felt on all sides. This found expression in the first Sacramento-San Joaquin River Problems Conference, which was held in Sacramento January 25th and 26th, 1924, under the auspices of the California Division of Water Rights and the Sacramento Chamber of Commerce.

Through the medium of authoritative papers presented by experts this conference brought out clearly for discussion the many angles to the problems from the standpoint of the up-river water users, the delta irrigators and the navigation, power and industrial interests. A committee known as the Permanent Committee of the Sacramento-San Joaquin River Problems Conference was appointed to "—prepare a program for the co-operation, adjustment, and development of all irrigation, power and navigation interests, with a view to securing the utmost conservation and use of the waters of the Sacramento and San Joaquin Rivers and their tributaries for the protection and benefit of all."

Since the first conference this committee has functioned actively and has proved to be a powerful influence in welding together the divergent interests involved, in bringing about constructive co-operative effort and in preventing litigation in the face of critical situations that have arisen.

Early in 1924 the Permanent Committee, in co-operation with the Division of Water Rights, instituted a definite plan of action to carry through the irrigation season. This called for an agreement among the water users and other interests to provide for a Water

THE SACRAMENTO
Provider—and puzzle of an empire.

Supervisor to be appointed by and work under the direction of the division.

In specifying the functions of such an official there were certain considerations which should be clear. In a previous article of this series* it has been brought out that the ultimate objective of all water legislation and administrative effort is the distribution of the water itself to those having a valid claim upon it; that where the water titles on a stream have been definitely adjudicated, this is readily accomplished through a State Water Master; and that, in striving to consummate the prerequisite clearing of water titles, three courses are open: (1) litigation, (2) the code provisions of the Water Commission Act, and (3) mutual agreement based upon investigations and determination of physical fact.

*See December, 1925, issue of "Modern Irrigation."

In 1925, in the Sacramento-San Joaquin territory, the use of water under the various classes of water rights was about as follows:

For the Sacramento River and tributaries in the valley above Sacramento, old appropriative rights (initiated prior to the Water Commission Act) 620,700 acre-feet.

Appropriative rights under applications to and permits from the Division of Water Rights, 610,200 acre-feet.

Presumably riparian rights 66,100 acre-feet.

Of 227,000 acres irrigated in the delta in 1925, a considerable portion is covered by appropriative filings before the division and practically the entire delta area of more than 400,000 acres claims water under riparian rights. Under such conditions, with litigation naturally repellent, the third of the above mentioned courses becomes the one most practical and applicable to the present case at least for some time to come.

With the facts of water supply, actual water requirements and use definitely established through engineering investigation, experience has proven it perfectly feasible to base thereon mutual agreements, either temporary to tide over an immediate crisis or more or less permanent, under which a Water Master or Water Supervisor may successfully distribute and conserve for the best interests of all, a deficient water supply. The Water Supervisor's authority and bene-

(*Continued on Page 22*)

One of the largest irrigation pumping plants on the Sacramento is this Tisdale plant of the Sutter Basin Company, near Grimes. Its average capacity is 600 second-feet. Records of the Water Supervisor show a diversion of 136,000 acre-feet at this plant in 1925.

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"Winning of the West" League Is Answer to Hoover's Plea for Reclamation Team Work

Delegates from All the Western States Meet in Los Angeles and Effect Organization to Promote Broad Program of Water Development

A MODERN IRRIGATION STAFF REPORT

THE challenge that Herbert Hoover so recently flung to the west has been accepted. On October 15, in response to Hoover's plea for a broad, national program of reclamation, delegates from all the western states met in Los Angeles and founded the "Winning of the West" league, hoping that it will later become the western section of a nation-wide organization for the development of the country's resources.

Secretary Hoover, it will be recalled, was the guest of honor at a Chamber of Commerce luncheon in Los Angeles on September 8. His address dealt chiefly with the development of the nation's water resources. "Water is the greatest undeveloped resource in America today," he declared. "There are 25,000 miles of inland waterways of which less than 6,000 is in use. There are also 30,000,000 acres of land that may be reclaimed by proper water development. The undeveloped resources now going to waste each year amount to billions of dollars. . . . We must no longer think in terms of single power sites or single storage dams or single land projects, or single irrigation improvements; we must think in terms of the co-ordinated, long-view development of the national resources."

The Seed Germinates

As in the parable of the sower, some of the seed may have fallen by the wayside, some upon stony places, and some among thorns, but certain it is that some fell into good ground and sprang up and give every promise of bringing forth fruit a hundredfold.

Arthur S. Bent, president of the Los Angeles Chamber of Commerce, began immediately to consider what could be done to get action on the Secretary's suggestions. The result was an invitation sent out to the governors of all the Pacific and Rocky Mountain states, to the presidents of the various irrigation projects and development leagues, and to any others known to be actively interested in water development questions, asking their co-operation in a conference for "Winning the West," to be held in Los Angeles, October 14 and 15.

In response to this invitation some two hundred delegates assembled in Los Angeles for the purpose of discussing those matters of moment that were of more than local importance. One of the noticeable features of the meeting was the spirit of friendly co-operation prevailing.

THOMAS E. CAMPBELL
Ex-Governor of Arizona and chairman of the committee appointed by the newly-organized "Winning of the West" League to confer with Herbert Hoover on reclamation problems.

There was "no set program to be put through, and nothing to be put over," as one speaker expressed it. The meeting was an open forum in which all the delegates sought to gain information regarding each others' projects.

Ex-Governor Campbell Presides

Thomas E. Campbell, ex-governor of Arizona, was elected chairman of the meeting. He emphasized that the conference was no place for controversy—that they were come together to ascertain the wishes and views of the various states for the use and development of their mutual resources, and that their desire was to discuss what could be done for the common good of all. Mr. Campbell stressed the fact that this movement could not be local nor even western, but that the west must join with all sections of the country. "I hope," said he, "that this convention will be the birthplace of one of the big movements of the age."

With the purpose of putting before the convention the facts regarding the different projects, representatives of the various sections were asked to tell of their problems and of the plans that were being made for solution. Hervey Lindley, of Seattle, president of the Columbia Basin League, and I. E. Vining, of Portland, president of the Oregon State Chamber of Commerce, told of the Columbia Basin project.

Mr. Vining's speech was a plea for action. "Too often," he said, "meetings of this kind are merely an emotional outlet. We come here full of our subject, and when we have talked everything over and discussed all our problems, our minds are relieved and we go home feeling as satisfied as if we had accomplished something. The question is whether there will be an organization effected following this meeting that will make it possible for Oregon to co-operate in this movement. If there is to be launched a permanent organization by which the people of the west can as brothers work together for the common good instead of each for his own benefit, Oregon wants a part in it. If Columbia Basin can join with the Sacramento-San Joaquin Valley and with the Colorado River, we will meet with you in the committee rooms of Washington and plan legislation for the work to be done. Oregon wants to co-operate—will you make it possible on a working basis?"

Speaks for Imperial Valley

John L. Bacon, mayor of San Diego and president of the Boulder Dam Association, spoke of the conditions in Imperial Valley that make immediate relief necessary. The inhabitants, Mayor Bacon said, face the danger of floods part of the year and water famine the rest, while what they need is a steady flow all the time.

"The East," he said, "is not interested in irrigation because it knows nothing about the need of water. It cannot realize that there are sections of this country in which *no rain falls at all.* Yet the State of New York has more votes in the House of Representatives than has the entire section represented by the Pacific and Rocky Mountain States."

The speaker outlined briefly the Boul-

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Keeping Out of the Red With *Vegetable* Crops

Thorough Understanding of the Practices and Principles of Irrigation Will Turn the Trick

By R. G. RISSER

PROPER irrigation is a most important factor in the production of high yields and superior quality in vegetable crops and it may also have an important bearing upon earliness, size of product, carrying quality, and cost of production. Yet the irrigation of such crops is not rigidly standardized and it requires the watchful attention of the producer for best results.

The ability of the grower to maintain an adequate but not an excessive supply of moisture is often plainly reflected in the success of the crop and sometimes in the manner in which the product carries to destination when shipped. On the other hand failures in growing vegetables may frequently be traced to insufficient, irregular, excessive, or improper irrigation.

Soil a Big Factor

The frequency of irrigation and the size of the head in the furrows will depend largely upon the character of the soil and the lay of the land. More frequent irrigations are required on sandy soils than upon those composed of coarser particles. On such light porous soils the most common mistake is to irrigate too infrequently and too heavily, while on heavier soils the most general error consists of supplying insufficient water to wet the soil to a fair depth or allowing too little time for it to sub between the furrows.

The moisture holding capacity of one soil may be double the capacity of one of different type and for this reason, the two soils should receive quite different treatment in irrigation.

Weather Must Be Considered

Temperature, rainfall, high winds, humidity, sunshine, etc., should be thoroughly considered in connection with irrigation plans, especially if such conditions are out of the ordinary. General climatic conditions may properly be a guide as to the customary practice of a given district while the special weather conditions of a particular season should determine the deviations from the standard practice of the locality.

Cantaloupe field in the Imperial Valley showing the initial irrigation of beds to germinate the seed. The ability of the grower to maintain an adequate but not an excessive supply of moisture is often plainly reflected in the success of the crop.

Rates of transpiration and evaporation vary, being much greater in the interior sections and during hot weather than in the coastal districts or during cooler weather. On account of the higher vapor pressure of moist air surrounding the leaves, moist air retards transpiration of the plant while lower atmospheric humidity increases the transpiration rate. The velocity of the wind is also an important factor affecting the loss of moisture.

How Evaporation Takes Place

A large proportion of the moisture which escapes from the soil passes through the plants and their foliage, and a large proportion of the water which passes up from the roots into the tissues of the plants is passed off through the leaves and other green portions into the air. The rate at which plants exhaust

Furrow irrigation of a young potato crop in the San Joaquin Valley.

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The EDITORIAL

MODERN Irrigation

Reg. U. S. Pat. Off.
Published Once a Month
AT LOS ANGELES, CALIFORNIA, BY THE
PETROLEUM WORLD PUBLISHING CO. *Editorial and Executive Offices, 626 South Spring Street, Telephone Broadway 3262.* Branches: SAN FRANCISCO—447 SUTTER STREET, *Telephone Garfield 2772;* H. E. TAYLOR, *Manager.* CHICAGO—1163 MONADNOCK BLDG., *Telephone Wabash 8855;* JOSEPH E. O'CONNOR, *Manager.* NEW YORK,–56 W. 45TH STREET, ROOM 1105, *Telephone Vanderbilt 3672;* WERNER HAUPTLI, *Manager.*

OWEN BROWN, *President;* W. C. MONROE, *Vice-President and General Manager;* MINOR MOORE, *Secretary and Counsel.*

Business Dept.: WALTER C. MONROE, *General Business Manager;* CHAS. R. JOHNSON, *Mgr. of Sales Promotion;* FRANK V. LONG, *Advertising Manager;* ROBERT H. THIESS, *Special Representative.*

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By Annual Subscription in the United States and possessions, $2.00; Foreign, $2.50; Single copies on sale in the irrigation country, 20 cents. In ordering change of address, give both the old and the new address. Allow ten days for re-entries on the subscription list. Advertising rates and circulation data upon request. Checks should be made payable to Petroleum World Publishing Co.

Vol. II OCTOBER, 1926 No. 10

For Waterworks

THE California Section of the American Water Works Association is meeting in annual session at San Diego on Oct. 28, 29 and 30. It is the seventh annual convention of the California body, although the parent organization has been in existence nearly half a century.

When the association was young it was written into the by-laws that "the object of this association shall be the advancement of knowledge of the design, construction, operation and management of waterworks, and the encouragement by social intercourse among its members of a friendly exchange of information and experience."

It would be well-nigh impossible to measure the benefits that have accrued to mankind through the carrying out of this objective by members of the American Water Works Association. Space cannot be given here to the progress of waterworks over the last half century, but the middle-aged adult may look back over the period of the past that his memory can encompass and come to some realization of that progress without our recounting it on this page.

The idea behind a professional association such as this is in large measure responsible for this progress. The American Water Works Association has learned from long experience that developments cannot come from the unco-ordinated efforts of individuals, no matter how great their abilities. Like other societies in the public utility field, it is looking to strong active committees to co-operate on waterworks developments and on solutions to problems that beset the engineer. The organization has the utmost flexibility and is able to accomplish with a minimum of effort and expense, and without duplication of work, all the results attainable through co-operation.

A GLANCE at the program for the California Section's convention, printed elsewhere in this magazine, will serve to give some idea of the immense practical value of the association's work. Members from all parts of the state gather at these conventions and exchange experiences and information to their mutual benefit. This year, happily, invitations were extended to members of the profession in other Pacific Coast states to attend the convention, an innovation that should become permanent. With the participation of waterworks engineers from other coast states in the California conventions it is not difficult to conceive of the possible extension of membership in the section to embrace the entire Pacific Coast.

WESTERN WATERWORKS, the new supplement to MODERN IRRIGATION which begins on page 32, is dedicated to the belief that an intelligently directed press can aid immeasurably in the dissemination of these ideas and experiences of the waterworks men. For the time being WESTERN WATERWORKS will be a magazine within a magazine, but will always have as its primary concern all matters having to do with problems of water conservation and development (as they relate especially to domestic and industrial supply) that are so peculiar to the west. It will be a clearing house of current information on western waterworks. If it can attain some success in this direction it will consider its existence well worth while.

The Sensible View

HERBERT HOOVER, whose broad vision, coupled with an engineering training, enables him to encompass huge undertakings in their entirety without getting out of focus, has, in the course of a recent trip through the west, given voice to thoughts about reclamation and irrigation that should be shared by every thinking person concerned with this country's future development.

Water development in the United States, Hoover said before a Chamber of Commerce luncheon in Los Angeles, must not be considered a series of sectional propositions, but as one comprehensive national undertaking, inasmuch as the far-reaching effects of such development must, necessarily, be national in scope. There are many ramifications to the problem, but the task can be performed if the public can be made to visualize it as a national enterprise.

Such a public viewpoint as Hoover hopes for, while it seems, in theory, to present no stumbling block, is not quite so easy to effect in practice. The Colorado development, for instance, which ultimately will reclaim between 5,000,000

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POINT *Of* VIEW

and 6,000,000 acres of land, is the particular concern of the localities that will benefit directly from that development; but it is difficult to get anyone in the northwest greatly interested in it, just as it is no easy matter to arouse the interest of people in the southwest in projects that affect, more directly, the development of the northwest. And to make the problem yet more complex, the different communities involved in any large development, such as the Colorado River projects, can envision little else but their own interests and they generally fail to understand—or care to understand—the interests of their more remote neighbors.

The inevitable result is that the big projects which mean so much to the development of all the west, and to the United States at large, become snagged on petty sectional politics and in long drawn-out litigations. As Hoover puts it, "Politics and litigation create much feeling over water development, but not much development."

The sooner the Hoover attitude becomes that of every individual concerned, directly or indirectly, in the development of the nation's water resources, the sooner will that development be ushered forward on a scale that will insure not alone the prosperity of a particular locality, or of a certain state or group of states, but the nation as an economic whole. We shall stand socially, politically, economically, as our country does. There can be no mistake about that.

The Short-Sighted View

THE fact that Secretary Hoover has so recently been in the west and given voice again to his reclamation theories makes the jolt all the more severe when one picks up the October issue of *Farm and Fireside*, a widely read farm journal, and reads on the very first page that "Reclamation Has Failed."

The editor of this publication states that the "reclamation policy of the United States has been premature." "The nation has no need for new farm lands," he declares. "The government should complete its obligations to the settlers on established projects. The beginning of any new works before the nation requires more food supplies must not be permitted."

This expression accompanies an article in the magazine by Arthur P. Chew, of the Division of Information, Department of Agriculture, who says that the governernment's reclamation policy is a failure because reclamation isn't needed.

The view is not new, of course. It has been expressed again and again by disgruntled settlers, individually, and farm organizations of one kind and another, collectively. But appearing in black headlines in a magazine of the repute of *Farm and Fireside*, the statement that "reclamation has failed" can do much more harm than good. For, as a matter of fact, reclamation *has not* failed.

It is the easiest thing in the world for the swivel chair thinker to jump to the conclusion that additional farm land is not needed when he reads of failures on reclaimed lands in the west. It is the kindest view, perhaps. It spares the feelings of the individual settler, who has been coddled by the government from the time he set foot on his homestead and isn't used to criticism; and it spares the management of the projects that have shown up in the red. Uncle Sam has been criticized by experts. Blame him.

SOMEONE has been unkind enough to say that failures on reclamation projects have been due to the weakness of the settler who, unable to make a living at anything else, has turned to farming on government land because "it doesn't cost anything." In other words, the thought is that life is a survival of the fittest, and those who settle on federal projects just aren't fit.

We cannot subscribe to a view which not only does an injustice to the pioneers on reclamation projects, but is, as well, an implied slander on those earlier pioneers who first crossed the hot sands to initiate the settlement of the west. But we do feel that the failure has not been with the idea of reclamation, but rather with the individuals concerned with the settlement of these projects.

It is too much to expect to make a successful dry land farmer over night out of one who has lived all his life in a humid section or who never had any farming experience before taking up a homestead. But it is not too much to expect that the active management of government projects be blessed with a reasonable amount of intelligence and an understanding of the dry farmers' peculiar problems that would assure the latter of practical co-operation and advice and not hot air and indulgence.

THE view that "the beginning of any new reclamation works before the nation requires more food supplies must not be permitted," is entirely uneconomic, the answer to which is best expressed in Herbert Hoover's own words:

"I would," he declares, "be opposed to such development myself were it possible to bring it about in a few days. But it must be remembered that these projects take time. Even if the program I have outlined could be started tomorrow it would be at least fifteen years before it would affect agriculture. At this moment we could not make economic use of the whole of this power or all this land, or all these inland waterways—but we will need the whole of it within half a generation."

The opposition to reclamation and waterway development from the agriculturists on the one hand, who fear overproduction, and from the railroads on the other, who fear the competition of water shipping, may be a natural reaction, but it reflects a distressing lack of foresight. Those whose vision can hardly encompass the future beyond the setting of today's sun should bear in mind that careful estimates place the population increase of this country in the next quarter of a century at 40,000,000. Certainly efforts must be made during the next ten years to stimulate agricultural production to provide food for this increase.

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Two Rivers' Epic Problem

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fits to be derived from its exercise will extend only so far as the water users' mutual agreements permit it.

Mutual Settlement Works

In the 1924 agreement adopted by the Permanent Committee and signed by the water users, provision to meet the immediate season's crisis was made in specifying the duties of and delegating certain authority to the Water Supervisor as respecting conservation measures and waste prevention. Looking more to the future, however, and to the ultimate solution of the problems it was specified that the Water Supervisor should commence the engineering investigation, the collection and recording of the hydrographic facts, most essential to an intelligent and permanent settlement in water difficulties of this nature.

The success attendant upon the 1924 conservation efforts was most noteworthy. The water users acceded readily to requested measures and accomplished much in the way of waste prevention and a careful use of water. After June there was not sufficient flow in the Sacramento River above Sacramento to maintain navigation, and, taking a lenient attitude, no attempt was made on the part of the U. S. War Department officers, charged with the maintenance of navigation, arbitrarily to enforce the superior legal rights of the federal government in this respect by enjoining water diversions. This confined the problem chiefly to the irrigationists and the pressing necessity of keeping fresh water flowing to the delta to save great areas of valuable crops there from the salt water encroachment.

Through appeals made to the up-river water users by delta owners, members of the Permanent Committee and others at a meeting of water users called at Colusa by the committee at the time of the crisis in the last of July, the river flow was decidedly increased, and the salinity actually driven back many miles in the Sacramento Delta. The estimated saving to the delta resultant therefrom was decidedly worth while.

The engineering investigation commenced in 1924 and continued to date has included the following: measurements and records of all diversions of water from the Sacramento, Feather, Yuba, American and Lower San Joaquin Rivers within the valley floor and above the delta; stream flow measurements throughout the territory, partially in co-operation with the Water Resources Branch, U. S. Geological Survey; measurement and record of waters returned both to the Sacramento and San Joaquin Rivers; intensive studies of the duty of water on peat and sedimentary lands in the delta region in co-operation with the U. S. Department of Agriculture, Division of Agricultural Engineering and the University of California Agricultural Experiment Station; yearly census of irrigated areas and crops under all diversions recorded and throughout the delta; and investigation and study of the advance and retreat of salinity in the delta channels.

Pump Diversions Prevail

With the exception of four large gravity systems, all of the diversions recorded are by pumping. The diversion records obtained in 1925 included 194 on the Sacramento River above Sacramento, 31 on the Feather River, 5 on the Yuba, 28 on the American and 32 on San Joaquin River Channels diverting to the delta uplands. The Sacramento River records show that there was a draft above Sacramento amounting to 953,000 acre-feet in 1924 and 842,000 acre-feet in 1925. A considerable portion of this draft is returned to the river, however, and the return water is available for use in the lower river and delta. The flow of all channels carrying this return water to the river is measured and recorded. The 1924 measurements indicated a return above Sacramento for the four months, June to September, equal to 33 per cent of the draft. The 1925 figures showed a corresponding return for July to October equal to 40 per cent. Each season three complete series of return water measurements have been made on the San Joaquin River and tributaries.

Within the delta it is not feasible nor practical to measure and record the countless number of diversions by siphon, gravity and pumping as well as the concurrent drainage pumping, which is considerable. Here the consumptive use of water must be estimated by applying the best "duty of water" figures obtainable to the various areas irrigated and cropped as shown by the yearly census. The proper determination of the "duty of water" data for peat and sedimentary soils, for different crops, etc., is the somewhat difficult task here involved. The detailed and intensive investigations along this line to date have been conducted on Medford and King Islands near Stockton for the peat soils, and on Reclamation District Number 999 near Sacramento for the sedimentary soils. This work has required the installation and use of many different water measuring devices and calls for a considerable amount of ingenuity and skill upon the part of the engineers in getting reliable results.

The encroachment into the delta channels of salt water from San Francisco Bay when in dry seasons there is insufficient flow of fresh water in the rivers to hold it back is a serious problem. Each season investigations have been carried on to determine, by means of testing water samples taken at two or four day intervals at stations throughout the delta, the movements and behavior of the salinity. Chief of the objective in this work is the determination of the relation existing between the advance and retreat of the salt at various delta points and the discharge of the rivers to the delta. With records of the Sacramento River flow at Sacramento and the San Joaquin River flow near Vernalis available since 1924, the work to date has demonstrated this relation within somewhat wide limits. Should reservoir storage become available at some future time as a means of controlling the salinity, the value of a knowledge of the required discharge and proper time for storage release is obvious. As an aid to the delta irrigators in avoiding the use of water with too high a salt content, bulletins showing the results of the tests are mailed throughout the delta once a week or oftener during critical periods.

Approaching Danger Mark

In the present season, with the bay drainage run-off estimated at about 50 per cent of normal, the situation has closely approached that of 1924, principally due to this year's much greater rice acreage, about 150,000 acres. The 1924 acreage was about 100,000. A greater late Spring run-off helped considerably, however, and caused the salinity encroachment in the delta to be from 30 to 40 days later than in 1924. In early August, critical stages had been reached in the vicinity of Colusa and the salinity was advancing rapidly into the delta. Navigation above Sacramento became precarious in early July and at the instance of the U. S. War Department an appeal was made for conservation to assist in its maintenance. Excellent response from the water users was received and all that could be accomplished through waste prevention and voluntary diversion reductions was done. With river levels continuing to drop, however, and navigation suspended, it is evident, as this is written, that navigation could now be maintained only through the actual elimination of a considerable irrigated area.

At the close of the 1924 season's work which, it should be noted, was almost entirely financed by the water users

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A dragline with features a dragline should have

Talk to contractors who have put Northwests on jobs where other machines were working. Many of them will tell you that Northwest draglines increase their output from 15 to 30 yards hourly. That is what comes with Northwest features, features a dragline should have.

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THE HYDRAULIC DIGEST

A Monthly Bulletin Board of Brief Facts and Events from Far and Near

Stony Gorge Dam Contracted

The Amburson Construction Co. of New York has been awarded the contract for the construction of the Stony Gorge Dam near Elk Creek, California. The Orland project water supply will be doubled by the completion of the dam.

McKay Dam Is Almost Ready

At McKay Dam, Umatilla project, Oregon, all concreting on the face of the dam has been completed, says a report from the bureau of reclamation, and the spillway gates and lifting devices have been installed. This dam will store 75,000 acre feet of water.

Redmond Looks to the Future

Redmond, Washington, has bought one hundred and sixty acres of land for future water development, according to the report made by the town council. The land purchased contains a natural flow of springs. Tests made of the water show it to be of excellent quality. They have been busy with the repair of water mains in the present system, and has laid considerable new pipe.

Turns Projects Over to Users

The bureau of reclamation has turned over to the water users the operation and maintenance of a number of federal irrigation projects and divisions, says a recent announcement from the Department of the Interior. The projects affected are located in Idaho and include several divisions of the Boise project, the King Hill project and the south side pumping division of the Minidoka project.

Ask Repair of System

The West Side Water Users Association, Lakeview, Oregon, has sent in a complaint to the officers of the Goose Lake Irrigation System, stating that the system was not in good repair and that it would not supply the water from the reservoirs without great waste. The irrigation company, it is reported, has assured the association that repairs will be made so that water can be distributed properly during the next irrigation season.

El Paso Boosts Water Charge

Due to $40.000 worth of flood prevention and corrective work done last year by the reclamation service, and to $17,000 suspended revenues, the minimum per acre charge for water in the El Paso, Texas, irrigation district will be increased 50 cents, making the minimum $2.60. There are 59,500 acres in the irrigation district now subject to repayment to the government of storage, irrigation and drainage costs, according to the statement recently sent out by the district.

Flood Control Office Closed

The flood control office of the California Department of Public Works was closed on October 1 because of lack of funds for its maintenance. State Engineer Paul Bailey reports that in the new budget for the department he is asking for an appropriation for the maintenance of the office, but he does not think it advisable to ask for an emergency appropriation for the conduct of the office until such time as the budget fund might become operative.

Power Plant for Cane Irrigation

Electric power is to be used for irrigation purposes in Honolulu, according to a report from the Chamber of Commerce of that city. The stockholders of the Pioneer Mill Co., in Honolulu, have voted to issue bonds for $1,500,000. A power plant with a 3,000-kilowatt steam turbine, which will supply power to operate high-lift pumps, will be built. Double the supply of irrigation water is needed for new varieties of cane which yield twice as much sugar as ordinary cane.

Saratoga Outlook Is Improved

The outlook for accomplishment of the Saratoga irrigation project (Wyoming) is more encouraging, according to a report from state engineer Frank C. Emerson on his return from an inspection of the project in company with representatives of the federal government. The project contemplates the reclamation of 38,000 acres in southern Carbon county, with water from the North Platte river.

Tule Lake Begins Overflow

Reports from Klamath Falls, Oregon, state that Tule Lake, on the Oregon-California boundary line, is undergoing its annual rise earlier than usual this year and has inundated nearly 200 hundred acres of wheat land. Due to an earlier harvest season the damage to crops will not be as great as that of last year. The reclamation service established a border around the lake for leased land, and those who go below this deadline to plant do so at their own risk of inundation.

Work OK's. Okanogan Contract

Hubert Work, secretary of the interior, has approved the government's proposed contract with the Okanogan irrigation district in Washington for the construction of a pumping plant to relieve a water shortage of several years duration, according to a report by B. E. Stoutemyer, district counsel for the United States bureau of reclamation. Residents of the district must approve the contract by vote before it becomes valid. If the contract is accepted by the district, the government will expend not to exceed $300,000 toward the construction of a plant to pump water from the Okanogan river. The district will repay the money in 30 annual installments without interest.

Bids Asked for Coolidge Dam

Bids for construction work on the Coolidge dam on the San Carlos irrigation project, Arizona, will be received at the Los Angeles office of the Indian Irrigation Service, according to the advertisements issued by the Interior Department on October 11.

The Coolidge dam is the main irrigation structure on the San Carlos project. The project will embrace approximately 100,000 acres of irrigable land in the Florence-Casa Grande Valley in Arizona, 50,000 acres of which belong to the Pima Indians of the Gila River Indian Reservation, the remainder comprising lands in public and private ownership. Construction of the dam was authorized by Congress at a cost not exceeding $5,500,000.

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Two Rivers' Epic Problem

(*Continued from Page 22*)

themselves to the extent of some $17,000, a second River Problems Conference was called. This was held at Sacramento on December 12, 1924. The season's work was reviewed and the Permanent Committee presented its report and recommendations. This conference voted to continue the committee and recommended that the state legislature be asked to appropriate funds to continue the work of the Water Supervisor. This the legislature did and the appropriation made insures the continuation of the work until July 1, 1927.

Season's Work Surveyed

With the drawing to a close of the third season's operation under the methods and plans initiated by the 1924 Water Users Agreement, an outcome of the First River Problems Conference, an opportunity is presented to review such progress as may have been made in dealing with Sacramento-San Joaquin water problems.

Of prime importance, the efforts to date have come as a result of, and have strengthened, the spirit of co-operation, welding together the various diverse interests so as to make the best of the situation and avoid expensive and extended litigation. Following the Antioch Suit, one of much greater proportions was filed. The loss in time, money and retarded development which would be entailed by the trial of this suit is fearful to contemplate. But with the action of the River Problems Conference, the Permanent Committee and the State, this suit has not been pressed.

In the Permanent Committee and River Problems Conference there has been created a most fortunate medium for dealing with the problems involved; and at present, the committee, influential and representative, stands ready as the proper body to forward all constructive plans for bettering the river conditions.

In the collection of the three years' records of the use of water and other fundamental physical facts and data, a necessary and important step has been taken leading to ultimate adjudication, adjustment, mutual agreement or whatever will be consummated as a basis for water distribution.

The procedure to date has been to make the best of the situation through conservation. This includes Water Supervision or Water Master Service which is essentially a conservation feature. Until such time as additional water supplies are made available through storage or otherwise this will undoubtedly continue to be the best and only reasonable procedure.

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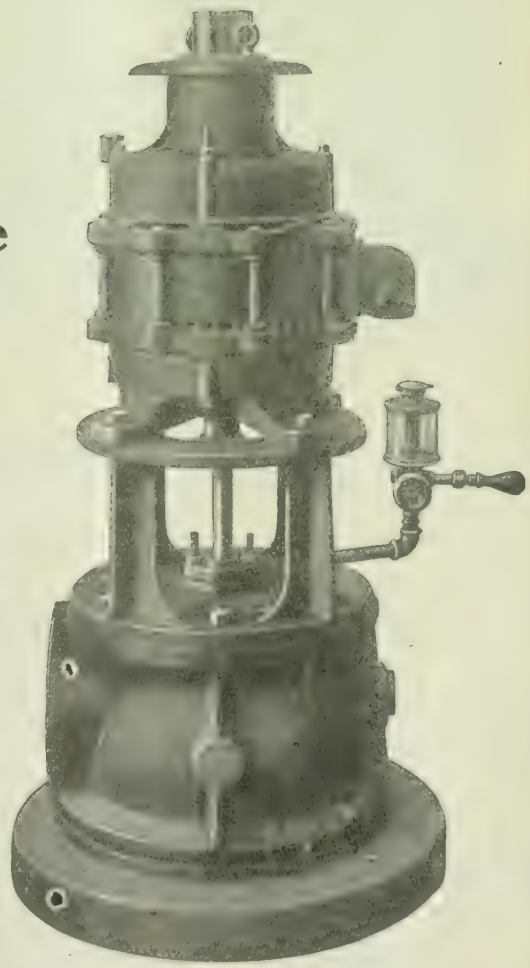

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RECLAMATION

Unified Program of *Orderly Reclamation* Is Keynote of Oregon Reclamation Congress

A WARNING against overemphasizing production in devising farm aid, with a resultant neglect of marketing, was sounded by Dr. Richard T. Ely in addressing the 16th Oregon irrigation congress, held at Hood River, Oregon, Oct. 14, 15 and 16. Dr. Ely, who spoke on "The Utilization of Land," is a professor of economics at Northwestern University and is in charge of the national bureau of land economics and public utilities.

Dr. Ely declared that the ills of the farmer have come from an over-abundance of cultivated land. Quoting Adam Smith, the noted Scotch economist, Dr. Ely said that the farmers of America today are the living examples of that axiom that those engaged in any line of activity which has obtained special favors, are certain to find their services receiving low pay. He cited how farmers throughout the land have been receiving aid from the federal and state governments, railways and numerous other sources.

Sees No Early Famine

Dr. Ely declared that agricultural colleges have directed their curricula disproportionately toward aiding farmers in ways and methods of bringing about production instead of providing studies that would result in farmers' profits.

He minimized the forecasts of those economists who foresee an early famine of foodstuffs. Dr. Ely cited the great reduction of animal population as a result of the introduction of motor propelled vehicles, and the release of land formerly utilized for feeding such stock, for production of foodstuffs for human consumption. He declared that at present the products of 61,000,000 American acres are being exported. However, said the speaker, investigation revealed that numerous foreign countries, to which America has been exporting were developing export surpluses of their own.

Dr. Ely expressed the belief that predictions of a population of 200,000,000 in America by 1959 are far from correct. His forecast is that the nation will have less than 150,000,000 and that the worries of a lack of food will not be apparent for several generations.

Urges Land Reclassification

As a remedy for the present disproportionate status of agriculture, Dr. Ely suggested a reclassification of lands and that all be put to those particular uses for which they are fitted. The state of Michigan, he said, has inaugurated such a system with the result that 6,000,000 acres of land have been purchased for reforestation. He declared that the policy of settling much of the cut-over or logged-off land of the country is detrimental to best interest of agriculture, but that state and nation should co-operate on a broad scale in a scheme of reforestation. Vaster tracts of land the speaker declared, should be utilized for recreational purposes.

Dr. Ely during the course of his address praised both the University of Oregon and Oregon Agricultural college for their efforts in aiding in the solution of agricultural and economic problems. He urged that the institutions be given larger appropriations for research work.

"Where you are now providing $1," he said, "you should be making available $20."

President Makes Address

Other speakers and topics on the first day of the session were: James T. Jardine, director of the Oregon experiment station, "The Use and Misuse of Water," and "Land Settlement," W. G. Ide, secretary of the Oregon state Chamber of Commerce.

President Wilfred Allen in his annual address, said: "While we have been most concerned as regards irrigation projects organized under state law with the rehabilitation and settlement of those already constructed, there is a general rejoicing that Oregon will get some measure of justice from the federal program. The announcement of approval of the great Owyhee project means that nearly $18,000,000 of federal money will come into Oregon to reclaim 124,000 acres of fertile soil. The federal authorities have been slow to recognize the demands of this state, and let us hope that a more liberal policy may now be maintained toward Oregon. The national government is always slow in development work of this character and by the time the projects can be ready for settlement there will be a crying need for the production of the area. Settlement will then come as a matter of course."

The address of welcome was delivered by Mayor Bennett.

The congress, it was declared, has the best representation from irrigated areas in its history, the registration included:

Mr. and Mrs. Z. O. Powell of Prineville;D, J. McLellan, Tumalo; E. T. Newby and O. Arnspiger, Talent; Ralph Cowgill, F. C. Dillard and John H. Carkin, Medford; Henry J. Kennard, Vale; Gail A. Hathaway, Thomas B. Kay, Fred H. Coshow, Salem; E. M. Wright, Bend; W. G. Ide, Portland; R. H. Dearmond, Warm Springs; Percy Purvis, Vale; C. C. Cignoux, Portland; Leslie Butler, George E. Goodwin, George R. Wilbur, J. H. Hazlett, Roy Hays, C. M. Hurlburt, E. E. Lage, Nels C. Hagen and John Plog, Hood River; R. H. Townsend, Portland; Walter E. Meacham, Baker; L. K. Cramb, Bend; H. A. Walthers, Medford; Marshall N. Dana, Portland; N. G. Wallace, Prineville; Walter A. Holt, Pendleton; George N. Angell, Portland; W. L. Powers, Corvallis; George Huntington Curry, La Grande; John S. Beal, Portland; P. Nelson, Redmond; W. A. Steward, Baker; E. T. Slayton, T. E. Thompson and W. B. Tucker, Prineville; H. R. Christensen, West Side, Lake county; Lester E. Elder, Summer Lake; P. G. Fortner, Lakeview; E. C. van Patten, Bruce R. Kester and W. J. Pinney, Ontario; E. M. Blodgett, Nyssa; C. H. Oxman, Vale; W. L. Shovell, Ontario; Willford Allen,

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Grants Pass; Delbert Utter, Portland; and L. R. Breithaupt, Corvallis.

Refunding Attempt Seen

State Treasurer Kay, addressing the congress, predicted a strong effort will be made to induce the next legislature to pass a measure authorizing the state to refund outstanding irrigation bonds amounting to $12,000,000 or $13,000,000. Such a measure, he prophesied, would not receive the necessary approval of a popular vote. He said he would strongly oppose such a move himself, and intimated many leading business men throughout the state had expressed similar sentiment.

As a substitute plan, Mr. Kay suggested the appointment of a commission to make a survey to determine actual value of the outstanding bonds, the bondholders placing the securities in escrow with the state until such valuation had been arrived at, when the state would reimburse the bondholders on the basis recommended by the commission.

Under this plan, Mr. Kay pointed out, the bondholders would share equitably in the losses suffered by the settlers. He said he believed the plan, if authorized by the legislature, would carry at the polls, the vote of the people being necessary under the 6 per cent limitation law.

Need for Industrial Growth

While favoring strong support of existing projects, Mr. Kay said he disapproved of launching new irrigation projects in Oregon for some time to come, declaring "more lands are available now than can be settled."

"Forget all plans for horticultural and agricultural expansion for the present," he urged, "and concentrate effort on encouraging industrial expansion. Only in this way can we create a greater consuming public to take care of the large surplus of farm productions which is keeping prices down and cutting into the profits of the producer."

Mr. Kay said he was not speaking officially in his capacity as state treasurer and ex-officio member of the land board, but chiefly to guide members of the congress in making suggestions for legislative improvements when the legislative committee meets.

Another View

Legislation alone will never cure the troubles of irrigation, Paul V. Maris, director of the extension service of Oregon Agricultural college, declared at the banquet of the congress. Much more, he said, is to be accomplished through scientific and intelligent use of the land. He cited the fruit industry of the Hood River and Rogue River valleys and the dairy industry of Tillamook county as examples of intelligent intensive farming.

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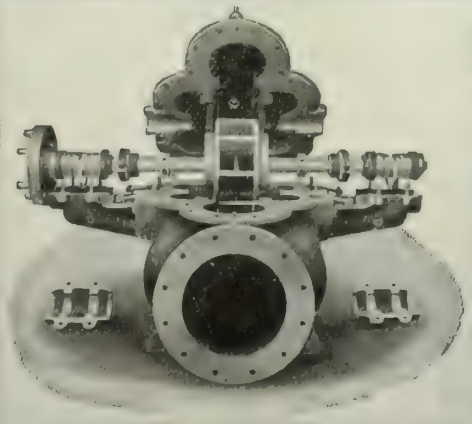

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Mr. Maris' department of the agricultural college, he told the banqueters, conducted during the last year an economic survey of the Umatilla reclamation project which resulted in a reclassification of the lands and brought the settlers on that project to the point of success. He invited the other irrigation districts represented at the congress to avail themselves of the various services of the college.

L. P. Jessup, drainage engineer for the United States department of agriculture, said in an address that the full significance of drainage had not been realized in the adaptation of waste lands and declared that full success would be realized only through joint use of drainage and irrigation.

More About Legislation

John Carkin of Medford, voiced the hope that from this congress would result workable remedial legislation for presentation at the next session of the legislature.

"Even though we had ready to place before this organization laws, fully drafted—and we haven't—I would recommend that they be withheld until after the November election," said Percy Cupper, ex-state engineer and member of the Oregon Reclamation congress. "We have kept Oregon irrigation out of politics in the past and we do not wish to throw it into politics now."

Walter E. Meacham of Baker expressed disapproval of the attitude of the committee, declaring that Mr. Cupper and his associates should have ready for presentation some actual definite recommendations on which the delegates to the congress might act in ratification or rejection.

Mr. Cupper said that his committee had reached the conclusion that the state should not be held responsible for the refunding of the irrigation bonds; that no moral responsibility attached.

Mr. Cupper proposed the appointment of some responsible commission with enlarged powers, the chief function of which would be to obtain responsibility of individuals in irrigated districts. He declared that legislation alone would not solve the irrigation problem, but that the settlers, the state and the bondholders must co-operate in an acceptance of losses.

Rhea Luper Speaks

Rhea Luper, state engineer, cited that ten of the state irrigation projects were in distress. The total bonded indebtedness of these reaches $6,014,000. Four of the ten districts in trouble are in permanent default. In some cases, he said, the taxes exceed the rental value of the land.

Mr. Luper recommended that Oregon irrigation laws be so revised that provisions similar to the Bancoft bonding act, under which the improvement of city streets in the state is conducted, be applied in such wise that blanket mortgages on systems be eliminated. Under such a system the settler who pays his assessments would be eliminated from assumption of the responsibility of other land owners who allow assessments to grow delinquent.

Imperial Profits by Water Sales

That American ranchers in Imperial Valley derived a substantial profit from the sale of water to farmers on the Mexican side of the boundary, is disclosed by the report of the Imperial Irrigation District engineer for the past year.

The report shows that the gross income from the sale of water to users in Mexican Imperial Valley was $630,258.64.

This sum not only paid for all canal operating costs in Mexico, but covered the administration expense for the headquarters office on the American side of the line, amounting to $96,693.39, canal-maintenance charges of $134,897.30, Boulder dam legislative expense amounting to $26,310.66, and all costs in connection with the diversion of water at the heading, and left a net profit to the district of $84,371.84.

The figures show that if Mexican users were charged only with their prorata of the total expense of the district the profit to the American owners of the system would be in excess of $400,000.

If it were not for the income from the sale of water to Mexican lands, the tax rate in American Imperial Valley would be approximately 50 per cent higher than it is, according to the assertion of local engineers.

Studies Irrigation Projects

A committee of three, according to an announcement made by the Bureau of Reclamation, has begun an inspection of representative irrigation projects in the West in connection with a study in progress into the operation and maintenance methods on irrigation projects. The inspection trip was begun September 22 and is expected to be completed by December 5, the bureau said. The purpose of the study is to determine what, if any, improvements can be made in the Federal reclamation service.

The committee is composed of Porter J. Preston, representing the Bureau of Reclamation; L. M. Holt, representing the Bureau of Indian Affairs; and R. S. Carberry, representing private irrigation projects. Headquarters have been es-

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tablished at Denver, Colo., where preliminary surveys have been made.

The projects to be inspected are: Uncompahgre project, in Colorado; Blackfoot and Ft. Hall Indian projects, in Idaho and Montana, respectively; a Yakima project, in Washington; Newlands project, in Nevada; Turlock project, a private undertaking in California; Yuma project, in Arizona-California; and Rio Grande project in Texas.

Clear Away 30 Miles of Logs

Opening of the Colorado River to its normal flow by clearing it of the great raft of logs which extended from its mouth up-stream for thirty miles is regarded as one of the most remarkable feats of its kind ever known in contracting circles, according to a report from Matagorda, Texas. For more than thirty years the river was blocked by this almost solid mass of timber, and with each flood the raft was extended up the river farther and farther.

The obstruction caused disastrous overflows of an enormous area in time of flood. In 1922 an overflow occurred which caused losses aggregating more than $3,000,000 to farmers and other interests.

The task was begun by dynamiting the raft at the mouth of the river and slowly progressed up-stream until the channel was opened a few days ago. For the first time in thirty years the river was opened and it is possible for small boats to traverse its entire lower course.

Besides obviating the dangers of overflow of a large area of rich land and the flooding of several towns, the removal of the raft will reclaim more than 100,000 acres of farm land that was under water by reason of the great log dam. This land will be planted to cotton, sugar cane, and other products, it is stated.

Studies Routes for Canal

A consulting board of United States reclamation engineers met in Ellensburg, Washington, on October 20, to recommend as to which of several alternate routes would be adopted for the main High Line canal for 12 miles above the Yakima river siphon. The first four miles of the main canal from Easton down are now under construction by the General Construction Co. of Spokane. Plans for the next ten miles have been completed and it is expected that bids for this section will be opened toward the end of November. For the last twelve miles of the main canal, the section above the siphon and the most difficult on the entire canal, plans will be completed and bids called for before winter breaks up so that work may be begun in the early spring.

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HYDRAULIC ENGINEERING

Dealing with the Practical Problems of the Operating and the Consulting Engineer

Interior Department Describes Engineering Aspects of Vale Irrigation Project

THE Vale Irrigation project, in the state of Oregon, is one of the six for which Congress, at its sixty-ninth session, made appropriations, and which, when completed, will cost approximately $54,000,000. The Department of the Interior has just made public a statement describing the proposed plan of construction of this project, as proposed by R. F. Walter, chief engineer of the bureau of reclamation.

The proposed Vale project contemplates the irrigation of 28,350 acres of bench and valley land lying mainly along the north side of the Malheur River in eastern Oregon, centering around the towns of Harper and Vale, above the present Warmsprings project.

The irrigation plan for this project is closely related to that of the Warmsprings irrigation district, which has constructed a reservoir on the Malheur River about 60 miles west of Vale with a surplus capacity over that required for the district lands. One-half of the present capacity of 170,000 acre-feet is to be purchased for the Vale project at a cost of $8 per acre-foot.

Raise Water Level

The installation of gates on the crest of the dam, which was provided for in the original plan, will permit the maximum water surface of the reservoir to be raised four feet and provide an additional 20,000 acre-feet of storage. This additional cost and capacity will be apportioned equally to each district.

Water released from the reservoir will flow in the channel of the Malheur River to a point about one mile west of Namorf. At this point a simple diversion weir, 12 feet high and 150 feet long, resting on rock, will be constructed.

This weir will require 4,000 cubic yards of excavation and 300 cubic yards of concrete. The canal head gates will be set at right angles to the crest of the weir at the left or north abutment.

From this point to the upper end of Harper Valley, a distance of about six miles, the main canal will have a capacity of 646 second-feet and construction will be difficult owing to the presence of rock, steep cross slopes, and conflict with the Ontario-Burns branch of the O. S. L. Railroad, which crosses the Malheur River immediately below the proposed point of diversion.

THE contract approved by the Department of the Interior provides for the expenditure by the United States of not to exceed $4,500,000 for (a) the purchase of a one-half interest in Warmsprings Reservoir from the Warmsprings irrigation district, (b) the construction of a diversion dam in the Malheur River in Sec. 6, T. 21 S., R. 41 E., Willamette meridian, (c) extending therefrom a canal system consisting of a main canal and branch canals and structures, and (d) the necessary drainage works, as found by the Secretary.

Upon the completion or termination of the construction program the Secretary of the Interior is to furnish the district a statement of the total amount of the construction costs payable by the district to the United States under the contract. The district is to pay the construction cost as stated by the Secretary.

If water becomes available for any part of the project before the completion or termination of the construction program as a whole, the Secretary is to give notice to the district to that effect, describing the legal subdivisions of land for which water is available, and giving the tentative per irrigable acre construction charge payable by the district on behalf of such completed portion of the project.

The canal will be carried under the railroad by means of a concrete culvert. For approximately one mile the canal will follow the north side of the river and will then be carried to the south side by means of a flume 800 feet long, of which 100 feet would be on a steel bridge.

For the next four miles the canal parallels the river on the south side to a point which is favorable for a siphon location, and where conflict with the railroad does not occur. At this point the canal is to be returned to the north side by means of a concrete siphon 1,015 feet long.

Engineering Problem

Owing to the difficult territory traversed by the canal a large amount of steel and concrete bench flume will be required. In this six-mile canyon section immediately below the point of diversion the aggregate length of steel and concrete flumes and siphons will be 14,000 feet.

After leaving the canyon the canal supplies water for the Harper tract. This is an area of 3,735 acres of bench and bottom land north of the Malheur River contiguous to the town of Harper.

Across the river from the lower end of the Harper tract is an area of 675 acres known as Little Valley. Water for this area is to be carried across the river by means of a second siphon. This is the only area south of the Malheur River for which works will be constructed.

Separating the Harper tract from the Vale Valley is a canyon about 6 miles in length. The conditions here are very similar to those encountered in the first six miles below the point of the diversion. Between the Harper and Vale Valleys the aggregate length of flumes and siphons will be 13,000 feet, in addition to which there is required 572 feet of concrete-lined tunnel 11 feet in diameter.

Vale Valley is reached at the end of this canyon, and the main canal thereafter has but one structure of importance, namely a 70-inch reinforced concrete siphon 6,200 feet long across Bully Creek.

Drainage is expected to be required on only a small part of the total area, principally in the Willow and Bully Creek bottoms.

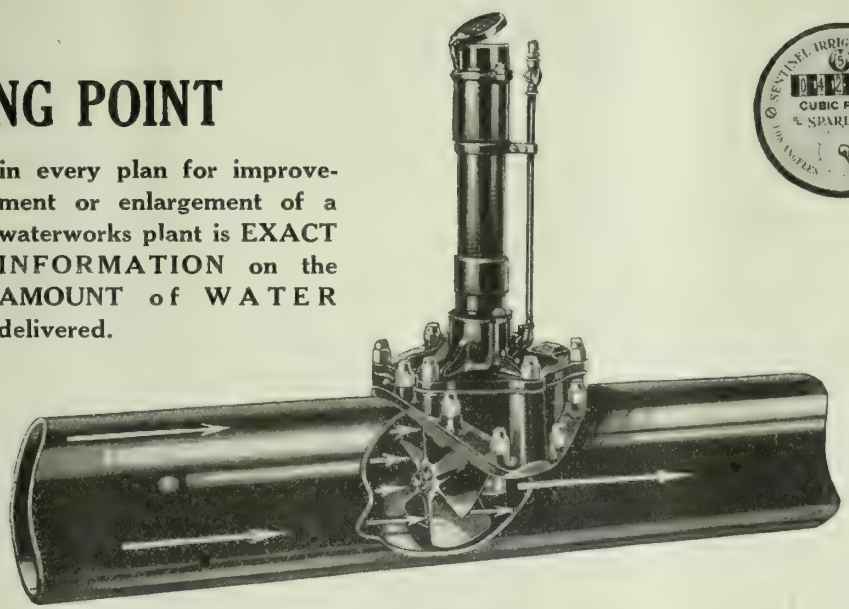
The surplus storage capacity of the

(*Continued on Page 77*)

See Page 33 for First Issue of "Western Waterworks"

THE BASIC STARTING POINT

in every plan for improvement or enlargement of a waterworks plant is EXACT INFORMATION on the AMOUNT of WATER delivered.



THE SPARLING MAIN-LINE METER

measures the total delivery thru pump or transmission mains, and gives this important information SIMPLY, CHEAPLY and POSITIVELY.

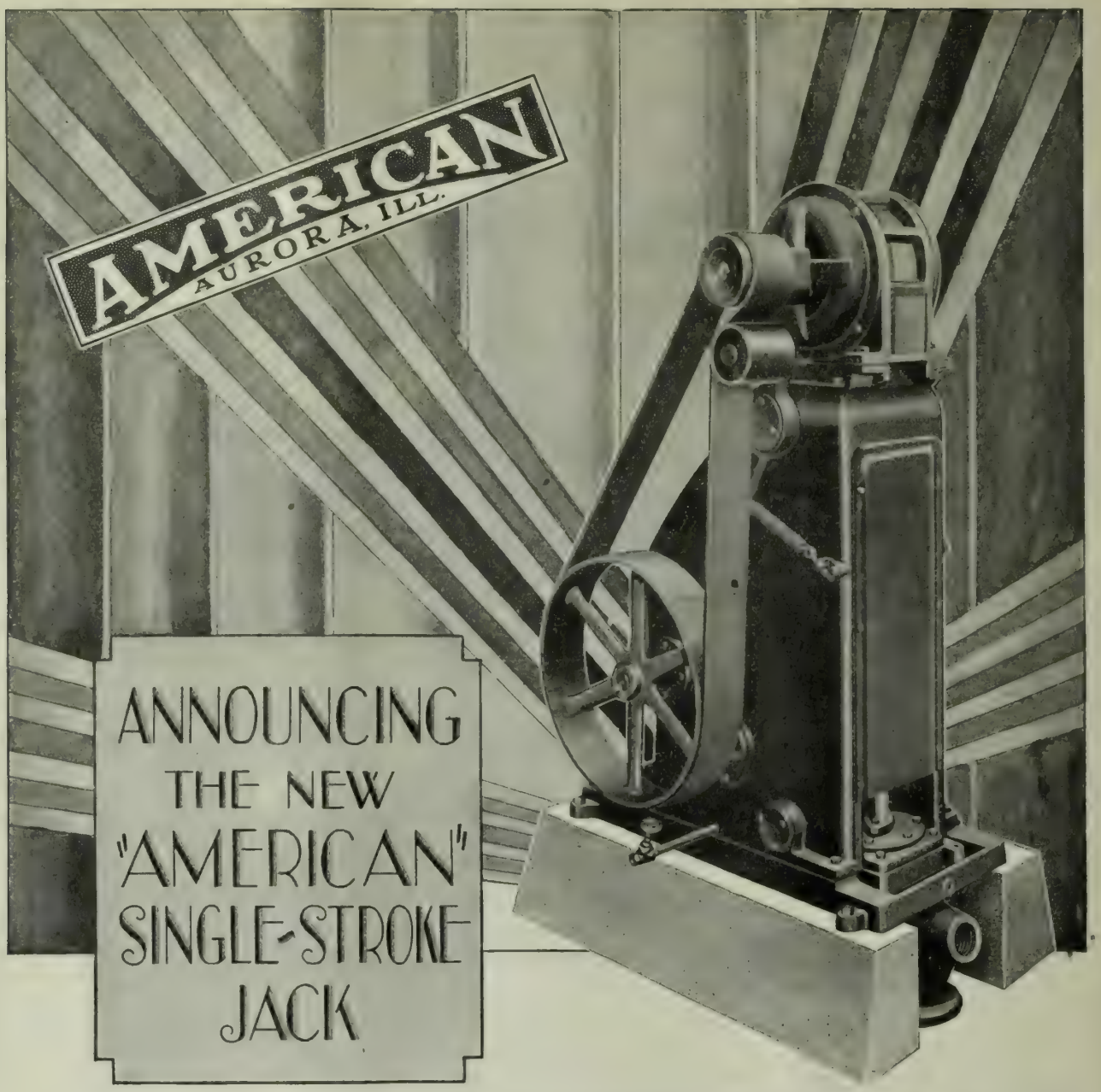
SIZE	Price F. O. B. Los Angeles		Minimum Flow in Gallons per Minute	Maximum Flow in Gallons per Minute
	Standard	Heavy Duty		
2"	$ 60.00	$ 75.00	15	150
4"	80.00	100.00	100	250
5⅝" or 6" O. D.	100.00	125.00	115	500
6"	100.00	125.00	125	550
7⅝" or 8" O. D.	120.00	150.00	140	900
8"	120.00	150.00	150	1,000
9⅝" or 10" O. D.	140.00	175.00	165	1,600
10"	140.00	175.00	175	1,700
11⅝" or 12" O. D.	160.00	200.00	200	2,500
12"	160.00	200.00	220	2,650
13½" or 14" O. D.	180.00	225.00	250	3,600
14"	180.00	225.00	270	3,800
15½" or 16" O. D.	200.00	250.00	300	4,500
16"	200.00	250.00	325	4,750
18"	220.00	275.00	430	6,000
20"	240.00	300.00	575	9,000

R. W. SPARLING

SAN FRANCISCO, 406 Mills Building

945-951 North Main, LOS ANGELES

See Page 33 for First Issue of "Western Waterworks"



THESE power heads are totally enclosed, self-lubricating, with gears operating immersed in a bath of oil, making a very quiet and smooth running power head.

The massive main frame serves as a complete housing and a rigid support for all working parts. The main gear is driven through a pinion which actuates a crank shaft, which in turn actuates an all-steel walking beam which operates the crosshead. This power head may be slid back upon its base, which permits the removal of the rods and drop pipe without tearing down the installation or disturbing pipe connections.

While illustration shows motor drive, these power heads can also be successfully operated with a gasoline engine.

They are made in both 18-in. and 24-in. stroke

These heads are more fully described in bulletins, sent on request.

BRANCH OFFICES:

Chicago, Ill. . . First National Bank Building
Milwaukee, Wis., Wisconsin National Bank Bldg.
New York, N. Y. . . . . 165 Broadway
Dallas, Texas . Western Indemnity Building
San Francisco, Calif. . . . 635 Mission Street

DISTRICT SALES AGENCIES:

Philadelphia, Pa.	Kansas City, Mo.	Denver, Colo.
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Cleveland, Ohio	Atlanta, Ga.	Phoenix, Ariz.
Detroit, Mich.	Birmingham, Ala.	Los Angeles, Calif.
St. Paul, Minn.	Jacksonville, Fla.	Charlotte, N. C.
Omaha, Nebr	New Orleans, La.	Calgary, Alta., Can.
St. Louis, Mo.	Roswell, N. Mex.	

The American Well Works

General Office and Works: **Aurora, Ill.**

See Page 33 for First Issue of "Western Waterworks" ☛

WESTERN Waterworks

Supplement to Modern Irrigation

Of Interest Expressly to Waterworks Executives, Contractors, and Municipal Engineers

California Section, A. W. W. A., Faces South for Its Seventh Annual Convention

MEMBERS of the California Section of the Water Works Association and others interested in the annual convention at San Diego, Calif., Oct. 28, 29, and 30, are, as this is written, packing their grips for the journey southward. The meeting will, without a doubt, be the largest of all the annual conventions that have been held by the state body.

Not only will the three-day session call to San Diego a representative gathering from the water works field in California, but there is a strong probability that Washington, Oregon, Arizona, and perhaps one or two other Pacific Coast states will be represented through the attendance of water works authorities from these sections. Special invitations have been sent out to water works officials in several of the Pacific Coast states outside California, and it looks as though Arizona will probably be especially well represented.

The point has been stressed by the officers of the California Section that while this is primarily a convention of the California group, all water works men and others interested in the topics to be discussed are cordially invited to be present and to participate in the discussion. Here is the way Paul Magerstadt, secretary of the section, puts it in his latest bulletin on the convention:

"You and your associates are invited to come, renew and add to your acquaintances among the water works fraternity. The personal contact will benefit you, your business and profession. Pass the invitation along. If you are interested, come. You are welcome whether you are a member or not, and lastly, remember the ladies are invited. It will be a splendid trip for them and special arrangements have been made for their entertainment."

The San Diego Hotel is the official headquarters of the convention and word has come from the manager of the hotel that accommodations at the hostelry were sold out for the convention early in October. It is, of course, desirable to keep the delegates together, but San Diego has a number of other first class hotels where accommodations are available. The San Diego Hotel will, however, be the scene of the official dinner and dinner dance.

A bang-up good entertainment program has been arranged by those in charge of this feature of the convention. Dudley's famous "Orpheus Four" whose singing gave the convention so much pleasure at Sacramento two years ago and again at Santa Cruz last year will again entertain at San Diego.

Here are the officers of the California Section of the association and the committees that, with the co-operation of the general membership, are going to put the 1926 convention down in history as the lucky seventh—the best ever:

OFFICERS

President

C. B. Jackson ..... Fresno

Vice President

S. B. Morris ..... Pasadena

Executive Committee

P. Diederich ..... Glendale

John Burt ..... San Rafael

Secretary-Treasurer

Paul E. Magerstadt ..... Oakland

COMMITTEES

Reception Committee

Andrew Ervest, Chairman, Manager Coronado Water Co.

(Continued on Page 92)

The Program

THURSDAY, OCTOBER 28

Forenoon, 10:00 A.M.: General Get-together Registration and Review of Exhibits.

Afternoon, 2:00 P.M.: Address of Welcome by Hon. John L. Bacon, Mayor of San Diego.

2:15 P.M.: "Description of the Impounding Works of the San Diego Water System" by R. C. Wueste, Supervisor of Impounding System, San Diego Water Department (Questions).

2:45 P.M.: "The Biological Control of Impounding Reservoirs" by Dr. Carl Wilson, Director of Biological Laboratory, Bureau of Water Works and Supply, City of Los Angeles (Questions).

3:15 P.M.: "Report on Water Meter Maintenance Methods" by J. H. Flagg, District Manager, Pacific Gas and Electric, San Joaquin Division, (Discussion).

4:00 P.M.: Five minute papers and discussions.

Evening, 6:30 P.M.: Informal Dinner, Banquet Room, San Diego Hotel. Business Meeting; Report of retiring officers; Report of committees; Election of new officers; Selection of next place of meeting. Address by William Mulholland, chief engineer of the Department of Public Service of Los Angeles on "The Colorado River Project."

FRIDAY, OCTOBER 29

Forenoon, 10:00 A.M.: "Progress in Electrolytic Chlorination at Sacramento Filtration Plant" by Harry N. Jenks, sanitary engineer, City of Sacramento (Questions).

10:30 A.M.: "Corrosion Problems of a Water Supply System and Methods of Protection" by E. B. Stewart, electrolysis engineer, East Bay Water Company, Oakland (Questions).

11:00 A.M.: "Equitable Charges for Automatic Sprinkler Connections" by Major William Cartwright, automatic sprinkler engineer, National Board of Fire Underwriters (Questions).

11:30 A.M.: Five minute papers and discussions.

Afternoon, 2:00 P.M.: "Underground Waters and Pumping Therefrom" by George W. Trauger, superintendent, Lindsay Strathmore Irrigation District and Edmund K. Barnum, engineer, Fresno City Water Corporation. Presented by Mr. Trauger (Questions).

2:30 P.M.: "The Duty of Water in General Municipal Uses" by Charles Lee, consulting engineer, San Francisco (Questions).

3:00 P.M.: "Iodine in Drinking Water" by C. G. Gillespie, director of state board of health, Bureau of Sanitary Engineering (Questions).

3:30 P.M.: Five minute papers and discussions.

FRIDAY, OCTOBER 29

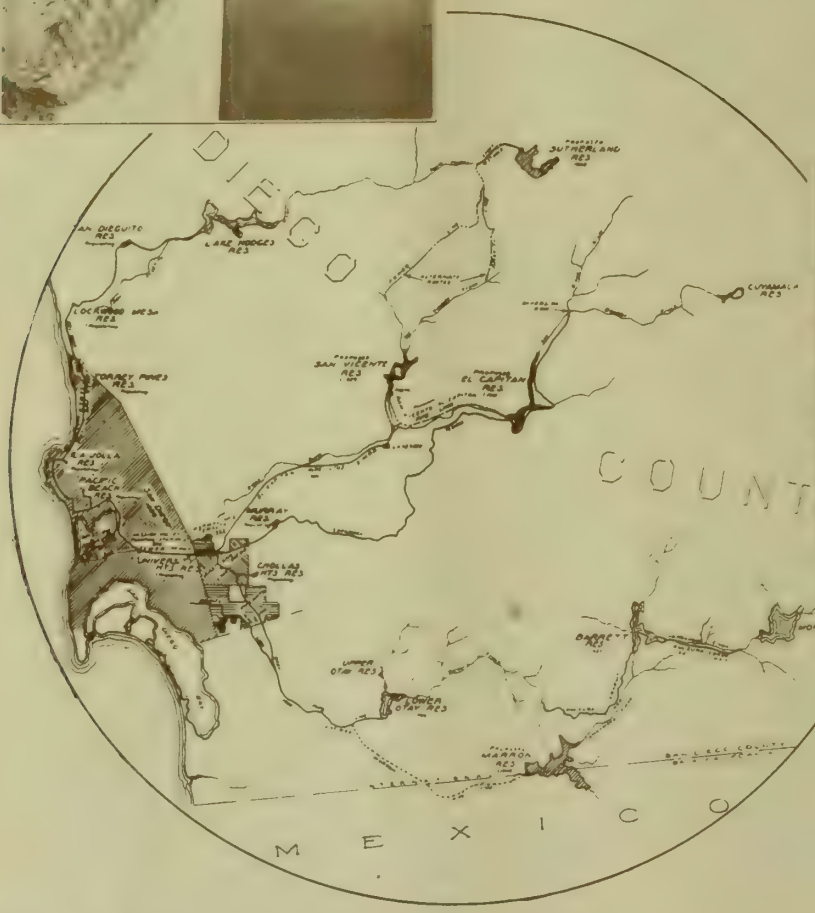
Evening, 6:30 P.M.: Dinner Dance, Informal, as guests of the Manufacturers in the banquet room, San Diego Hotel.

SATURDAY, OCTOBER 30

Morning, 10:00 A.M.: Leaving San Diego Hotel promptly at 10:00 A. M., automobiles will leave for trip to Lower Otay Dam and other points of interest of the San Diego Water System. Lunch will be served as guests of the City of San Diego at the Lower Otay Filter Plant. Return to hotel about 4:00 p.m. Ladies invited.

San Diego—the Host City Plans Its Water Supply for Decades Ahead

By FRED A. RHODES
City Manager of San Diego



This section of a map of San Diego County shows a comprehensive picture of the "Rhodes Plan" of water development for the city, by which it hopes to keep its water facilities a step in advance of population. Table I, on the following page, presents key facts respecting each of the projects represented on this map. INSET, LEFT: Barrett Dam, one of the largest projects in the plan, with a reservoir capacity of 14,498,000,000 gallons. INSET, RIGHT: Lake Hodges Dam, with its reservoir capacity of 12,000,000,000 gallons.

THERE is probably no other city of consequence in the United States, if not in the entire world, where such a peculiar combination of natural conditions and complications of circumstances unite to intrigue the ingenuity of the hydraulic engineer, as in the city of San Diego.

Time was when people up-state and elsewhere held the conviction that San Diego had plenty of climate and wonderful recreational facilities and scenic attractions—was a fine place to live in, but—*not enough water*. "Let San Diego get sufficient water and watch her grow!" was the exclamation of her well-wishers. Well, she is growing and she has the water. Now we'll go on with the story and prove it. And we'll tell what we are going to do.

Whenever the subject of water development is mentioned in connection with San Diego, one acquainted with the history of Southern California instinctively recalls the old romantic days of early Spanish settlements, and the pioneer struggles of the earnest Mission Fathers—history that extends back for more than a century and a half and embraces the earliest settlement in the United States. This was at 'Old Town' where, in the old halcyon days, ample water for the simple needs of the good people was readily obtained from convenient wells in the center of town.

First Irrigation System

From all accounts there were, even then, years when no rain came and periods when the nearby country was sadly in need of sufficient moisture to provide for stock and, as the community grew, it became necessary to sink additional wells in the bottom lands of Mission Valley, where the ground water was replenished by flood discharges of the San Diego River.

Later, but still more than a century ago, when the mission was established at Alta, by Father Junipero Serra, irrigation was conceived, and what is reputed to be the first irrigation project on American soil was instigated by the construction of the masonry dam across the channel of the San Diego River at Mission Gorge some ten miles upstream. From this diversion, well-constructed ditches, flumes and tunnels were built to convey the water over the fertile valley land theretofore unproductive for lack of moisture.

Such was the condition of affairs when "Father" (A. E.) Horton settled at the site of what is now San Diego—to the south of "Old Town" and on the shores of San Diego Bay. This new community at first depended on water hauled from wells at Old Town; later wells were sunk at more convenient places in the settlement itself; but the rapid growth in population soon required

a more substantial supply, and we come to the first organized effort to provide a water work system.

San Diego's Topography

Without attempting even a general description of the topographical and geological features of San Diego County it can be stated that it is divided into two principal districts; first, a series of terraces or mesas rising in steps from the ocean shore and extending from ten to twenty miles inland, gradually rising in elevation to a distance of as much as twelve hundred feet above sea level; second, a rugged mountainous area extending from the mesas easterly to the Imperial Valley. A considerable portion of this upland area rises to an elevation of four thousand feet or more above sea level, while an appreciable amount, around the higher peaks, reaches an elevation of six thousand feet, or higher.

The principal stream courses reach the sea through broad shallow valleys across the mesa lands, while in the mountainous area, with the exception of a few broad upland valleys, the streams flow in narrow precipitous canyons or between steep sloping hills. Occasionally, however, the larger water courses will broaden out into fair-sized valleys for an appreciable distance, and it is at these places that the good reservoir sites exist.

One of the outstanding features affecting the general water situation in San Diego County is the peculiarity of the climatic conditions, particularly the manner in which rainfall occurs from year to year. The average annual rainfall in the county varies from about nine or ten inches along the coastal belt, gradually increasing as higher elevations above sea level are reached, to fifteen inches and even twenty inches on the mesa land, and finally reaching as much as forty inches in the still higher mountainous area. The fairly steep slopes, found altogether in the mountainous area, combined with the rather barren character of a large portion of the catchment basins, are conducive to flashy runoffs and rapid accumulation of precipitation in the drainage channels.

Hydrography Records Interesting

Historical records indicate that the years of 1811, 1822, 1832 and 1842 stood out noticeably as flood years. The many recent records of the United States Weather Bureau show that 1874, 1884, 1895 and 1906 were all years of high flood discharge, while 1926 has again been a fairly high flood year. Saving floods can be relied upon to replenish the water supply at least once in ten years. The problem of providing a water supply and utilizing to the best advantage all the resources available to the city, while in no way a simple one, therefore narrows down to the construction of ample storage reservoirs to obtain the water when it is available, for use during the extended periods when the annual runoff is small.

TABLE 1—GENERAL RESERVOIR STATISTICS

Date Available to City	Name	Type	Stream	Height Above Stream Bed in Feet	Area of Water Shed in Sq. Miles	Area of Reservoir in Acres	Maximum Capacity Gallons	Net Safe Yield Gallons Per Day
1906	Upper Otay	Concrete Arch	Otay River	70.5	20	139.50	835,700,000	500,000
1906	Original Lower Otay	Rock Fill Steel Core	Otay River	132.0	85.7	809.2	11,638,300,000	1,900,000
1913	Original Morena	Rock Fill Concrete Face	Cottonwood Creek	146.0	119.5	1284.0	13,443,800,000	
1919	Rebuilt Lower Otay	Gravity Arch	Otay River	149.0	85.7	1301.1	18,979,500,000	3,300,000
1920	Hodges	Multiple Arch	San Dieguito River	130.0	300.0	1317.0	12,316,500,000	3,000,000 (to city)
1922	Barrett	Gravity Arch	Cottonwood Creek	170.00	130.05	881.6	14,512,200,000	4,400,000
1923	Enlarged Morena	Concrete Top Wall	Cottonwood Creek	155.0	119.5	1475.0	17,492,800,000	4,000,000
1925	Cuyamaca	Earth Fill	Boulder Creek	93.5	1.0	978	3,777,000,000	1,000,000 (to city)
1928	Sutherland		Santa Ysabel Creek	160	33.0	330	8,749,340,000	6,000,000
1929	San Vicente		San Vicente Creek		74.9			13,000,000
1931	El Capitan		San Diego River		190.0			12,000,000
1940	Marron		Cottonwood Creek		220.0			10,000,000

NOTE: Above given Net Safe Yields are at reservoir and do not include Transmission Losses

Any discussion of San Diego's water supply would be incomplete without at least some mention of the underground water in Southern California. The scarcity of perennial streams and the flashy runoff of the principal water courses has led to the exploitation of underground water resources to a degree not exceeded in any section of the United States.

Extensive studies of this source of supply have been carried on for years, and it is now well recognized that, at least within certain limits, the gravel filled valleys along the natural streams constitute more or less perfectly defined storage reservoirs; basins which are replenished annually by the stream discharge and surface runoff, and which are capable of being controlled in much the same manner as reservoirs above the ground.

To a certain extent, anyway, rights can be and have been established to the water supply thus afforded, and any contemplated control of stream runoff that might affect the replenishment of these basins must take into consideration the resulting consequences. This introduces still another feature that must be considered in connection with the development of water.

That the underground basins are valuable sources of water supply is well recognized by the city, which has already invested approximately one hundred thousand dollars in a series of wells, a battery of deep well turbines and a booster plant located in Mission Valley. A further development is now contemplated in the vicinity of Riverview, farther upstream on the San Diego River. Both of these plants promise to be vital safeguards in time of water shortage.

Water Rights and Lands

No attempt can be made to discuss in a brief manner the many complications arising from conflicting water rights. Like the poor man's dog, they seem to be ever present, especially in a community where water is valuable, and San Diego County is no exception.

Of all the western states, California is the only one where riparian rights receive much recognition, but in view of their standing in this state they must always be given consideration in planning a development. Thus the construction of storage reservoirs, or the diversion of water from one stream drainage into another, may seriously affect the water supply for riparian lands.

On this account the city has already purchased a considerable acreage of land in connection with the system now developed and is constantly purchasing additional land to safeguard future developments. Without attempting to cover this subject in detail it can be said that, at the present stage of procedure, the city has established what is believed to be unassailable title to all water necessary for many years to come and has successfully defended its interests against all adverse claimants that materially affect future development. Also, through the purchases of land now made and the options now held on additional lands, the principal interests of riparian water necessary for carrying out future development are under control.

Some Charts and Tables

Before proceeding further, reference is made to the several charts, maps, and diagrams presented herewith. On the

TABLE II—SAFE NET YIELD OF WATER SUPPLY, WATER CONSUMPTION AND POPULATION STATISTICS— CITY OF SAN DIEGO

	Supply			Consumption					Population		
Year	Safe Net Yield City System, Gals. Per Day	Per Capita Supply On Basis of 100 Gals. Per Capita		Total Used for Year in Gallons	Average Used Per Day in Gallons	No. of Taps	Gallons Per Tap Per Day	Gallons Per Capita Daily	Est. from Operating Dept. Data	Est. from City Directory	From U. S. Census Bureau
1902				588,597,892	1,612,596	3,562	452	75.45	16,029	21,692	17,700 (1900)
1903				734,405,550	2,012,070	3,792	530	88.43	17,064	26,692	.....
1904				771,049,665	2,106,693	4,238	497	82.84	19,071	28,755	
1905				761,022,655	2,084,993	4,860	429	71.47	21,870	29,126	
1906	(Aug.)	2,450,000	24,500	944,079,932	2,586,520	5,573	464	77.35	25,078	30,428	
1907		2,450,000	24,500	1,222,030,325	3,348,028	6,468	517	86.27	29,106	38,240	
1908		2,450,000	24,500	1,386,390,000	3,787,951	7,386	512	85.47	33,237	45,000	
1909	(Jan.)	5,870,000	58,700	1,412,560,450	3,870,028	8,264	468	78.04	37,188	46,000	
1910		5,870,000	58,700	1,653,369,304	4,529,779	8,870	510	85.11	39,915	48,000	39,578
1911		5,870,000	58,700	1,820,926,797	4,988,840	10,282	485	80.86	46,269	55,000	
1912		5,870,000	58,700	2,094,917,138	5,723,817	12,681	451	75.22	57,064	67,704	
1913	(Jan.)	7,570,000	75,700	2,503,962,800	6,860,172	14,153	484	80.78	63,688	74,533	
1914	(Dec.)	8,770,000	87,700	2,640,613,672	7,234,558	14,644	494	82.33	65,898	85,000	
1915	(May) (Oct.)	9,890,000 9,700,000	98,900 97,000	2,767,560,292	7,582,356	14,886	509	84.89	66,987	90,000	
1916	(Jan.) (Dec.)	7,300,000 7,000,000	73,000 70,000	2,957,839,198	8,081,527	14,707	549	91.58	66,181	90,000	
1917		7,000,000	70,000	3,151,112,331	8,633,184	15,171	569	94.84	68,269	90,455	
1918		7,000,000	70,000	3,622,614,470	9,924,971	15,021	660	110.12	67,594	94,955	
1919	(Sept.)	10,720,000	107,200	3,317,866,144	9,090,044	15,346	592	98.72	69,057	95,767	
1920	(Jan.)	13,720,000	137,200	3,559,523,969	9,725,475	16,358	594	99.09	73,611	99,481	74,683
1921		13,720,000	137,200	3,590,574,516	9,837,190	17,602	559	93.15	79,209	107,959	
1922	(July)	13,650,000	136,500	3,661,533,587	10,031,598	19,021	527	87.90	85,594	112,012	
1923	(Dec.)	14,170,000	141,700	4,340,394,563	11,891,492	20,614	576	96.14	92,763	126,876	
1924	(Feb.)	14,470,000	144,700	4,482,318,421	12,246,771	22,495	544	90.73	101,227	132,570	
1925		14,470,000	144,700	4,670,361,820	12,795,511	28,641	448	74.46	128,884	134,995	
1926										147,000	
1927											
1928											
1929											
1930											

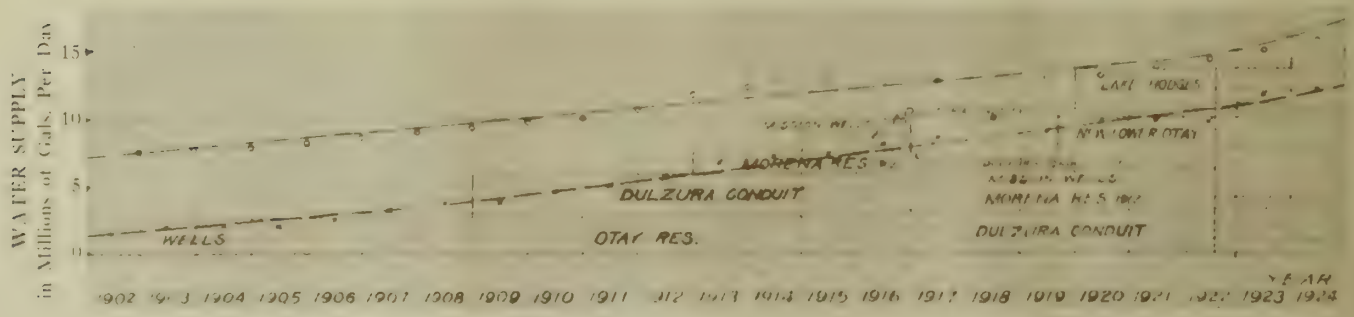
map reproduced on the first page of this article is shown the constructed water supply system to date, including the various reservoirs and conduits; also the proposed future development, under the plan of procedure now deemed most advisable. The years in which constructed units became available as sources of supply to the city, and the dates of completion proposed for the new work are also indicated in Table I. This table also gives the essential features of the different dams and reservoirs, both constructed and proposed.

Table II, entitled, "Net Safe Yields of Water Supply, Water Consumption and Population Statistics" shows the population which the net safe yield of the developed system would provide for, at any period, on the basis of one hundred gallons per day per capita; the actual consumption records, as compiled by the city's Operating Department; and the estimated population of the city, as derived from the different sources indicated.

On the chart appearing on the second and third pages of this article, bearing the title "Population, Average Daily Water Consumption and Available Water Supply Developed, and Proposed Future Development under Rhodes Plan," is shown, graphically, how the increase in demand for water can be aproximated by a curve based on past records; how the future population can also be estimated in a similar manner, particular attention being called to the experience of the City of Los Angeles, which has been incorporated into the study of future population for San Diego; and finally, the manner in which the different stages of past development combine to increase the total safe net yields at different periods, and how the future development will continue to add to the city's total supply.

A Critical Period

Notwithstanding the improved water service after the city took over the system from the old Consolidated Water



Company, in 1906, the situation soon became critical on account of the rapid increase in population. In fact, the scarcity of water was so great that the future welfare of the city was seriously threatened.

In order to bring about a financially capable organization, the Mt. Tecate Land & Water Company and the Otay Water Company were consolidated, in 1906, and taken over under the name of the Southern California Mountain Water Company. The late John D. Spreckels was induced to become actively interested in a financial way, and with characteristic energy, proceeded to rehabilitate the enterprise.

Negotiations were entered into for the purchase of the project by the city, and in the fall of 1912 the city exercised its option, taking over the entire system with the exception of Morena Dam and the lands connected therewith. The city later, in 1914, took over the balance of the system, consisting of the Morena Dam and a considerable acreage of land adjacent to Morena Reservoir.

Having finally taken over the development of its water supply as a municipal enterprise, the city at once voted several bond issues for the purpose of further development and improvement.

Extensive investigations had been carried on for some time past and were still being made, for the purpose of formulating some general program that would provide more adequately for future requirements. Numerous plans for combining various reservoir sites into a new system were given consideration, and the best engineering talent of the country was called into consultation.

Special attention was given to the construction of dams at Mission Gorge and at the El Capitan dam site, on San Diego River, also to the construction of dams on San Vicente Creek and on Santa Ysabel River at the Sutherland site.

Recent Developments

In the meantime, the demands of the city were constantly growing, and to provide an increased supply during the interval necessary for bringing about the construction of new reservoirs, negotiations were entered into for the purchase of water from the Lake Hodges Reservoir, on San Dieguito River, which had already been constructed by the San Dieguito Mutual Water Company.

An agreement was entered into in January, 1920, whereby the city was to be furnished with a maximum draft of three million gallons daily for a stipulated rate of payment, and suitable transmission works were built to convey this supply to the city's distribution system. This transmission works involved the use of San Dieguito, Rockwood, Mesa, Torrey Pines, La Jolla and Pacific Beach Reservoirs, for control purposes between Lake Hodges and different portions of the city's distribution system. A booster station was also necessary at Torrey Pines. With this 3 m.g.d. addition to the city's water supply the total net safe yield available was increased to 13.72 m.g.d.

In 1924, arrangements were made for reclaiming the wash water from the Lower Otay filtration plant, which heretofore had gone to waste. This improvement restored .30 m.g.d. to the net safe yield of the city system and brought the total supply available up to 14.47 m.g.d.

On December 1, 1925, the city acquired title to the entire San Dieguito system and to all excess water appurtenant thereto over the requirements of the vested irrigation rights.

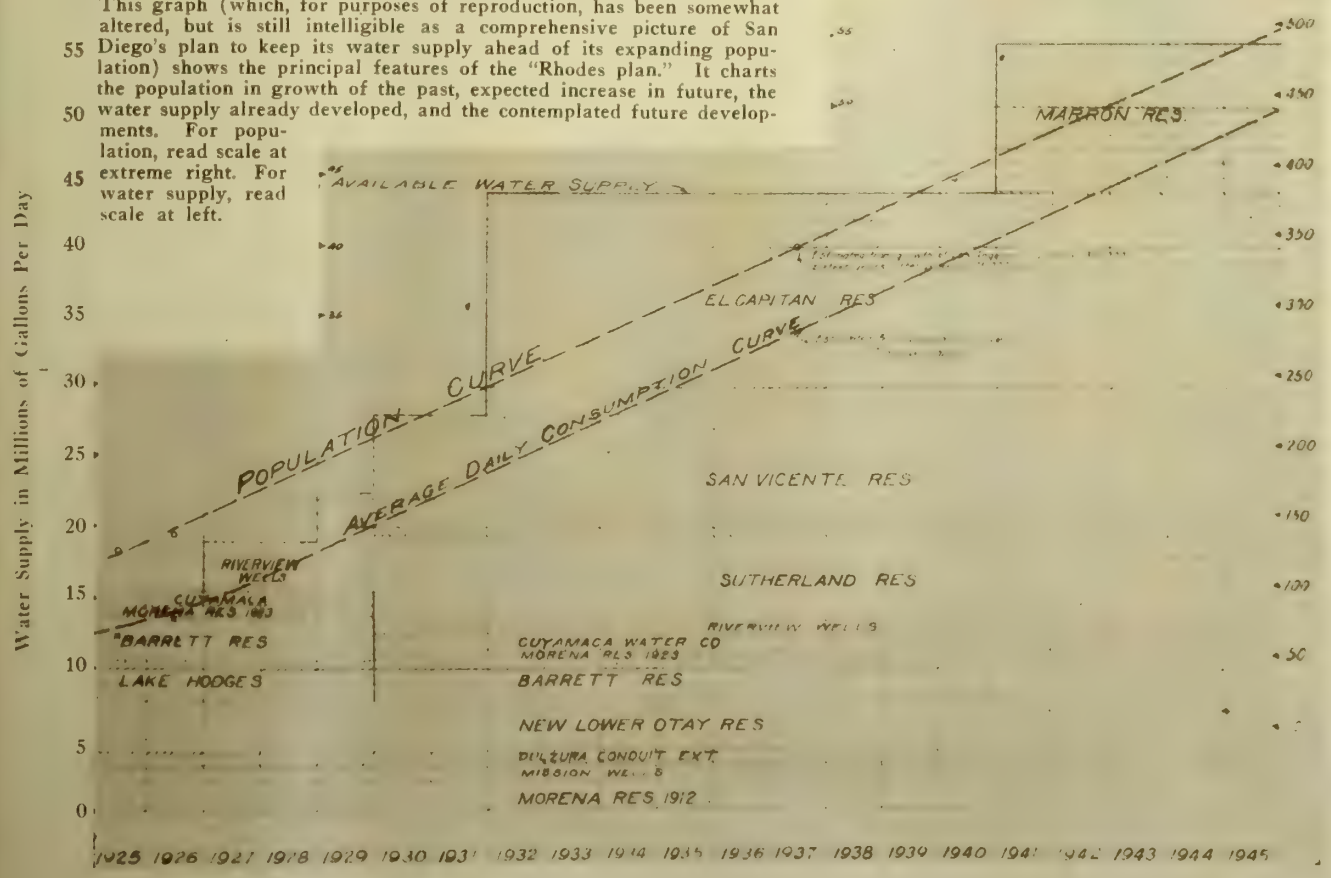
Again referring to the water furnished to East San Diego by the Cuyamaca Water Company, the 1.0 m.g.d. available from this source has been in reality an additional supply over and above all water heretofore given consideration. Thus, since East San Diego came into the city proper, the total safe net yield available to the city at the end of 1925 can be given as 15.47 m.g.d.

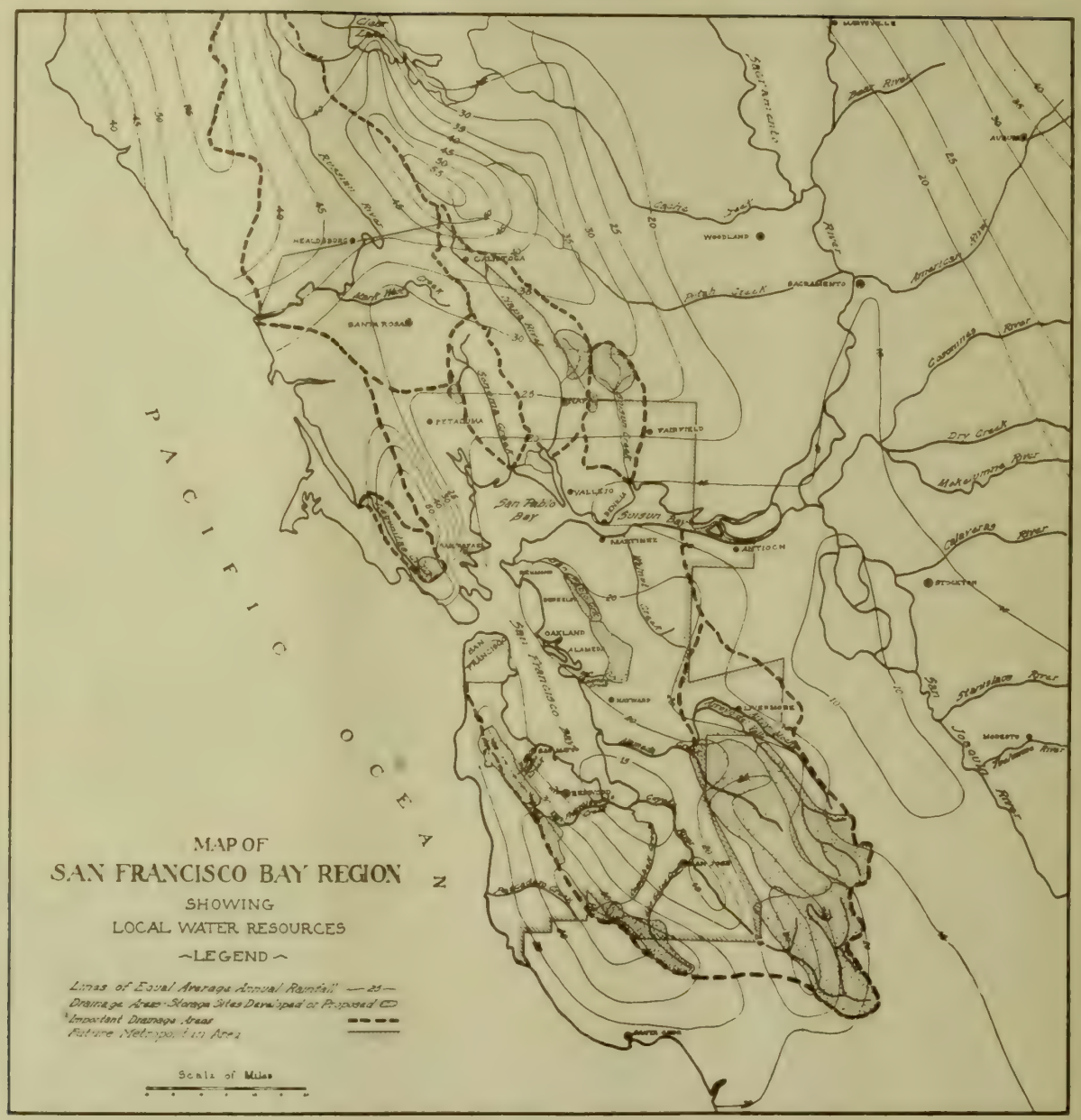
The 1926 program, which is already

(Continued on Page 44)

WATER AND POPULATION

This graph (which, for purposes of reproduction, has been somewhat altered, but is still intelligible as a comprehensive picture of San Diego's plan to keep its water supply ahead of its expanding population) shows the principal features of the "Rhodes plan." It charts the population in growth of the past, expected increase in future, the water supply already developed, and the contemplated future developments. For population, read scale at extreme right. For water supply, read scale at left.


Water Supply in Millions of Gallons Per Day
Population of San Diego (in Thousands)
AVAILABLE WATER SUPPLY
POPULATION CURVE
AVERAGE DAILY CONSUMPTION CURVE
MARRON RES.
EL CAPITAN RES
SAN VICENTE RES
SUTHERLAND RES
RIVERVIEW WELLS
CUYAMACA MORENA RES 1923
BARRETT RES
LAKE HODGES
CUYAMACA WATER CO MORENA RES 1923
BARRETT RES
NEW LOWER OTAY RES
DULZURA CONDUIT EXT MISSION WELLS
MORENA RES 1912
1925 1926 1927 1928 1929 1930 1931 1932 1933 1934 1935 1936 1937 1938 1939 1940 1941 1942 1943 1944 1945



Water Survey of San Francisco District Shows Urgency of Providing for Future

Many Peninsula Towns Have Reservoir Capacity for But a Few Hours' Supply, and Must Depend Entirely on Pumps

By CHARLES H. LEE

THE provision of an adequate supply of water for all purposes is a fundamental requirement of community life. Pure water is necessary for elemental domestic needs, and under modern conditions a plentiful supply is indispensable for the upkeep of municipal improvements, industry, and especially for fire protection. The schedule of the National Board of Fire Underwriters for grading cities with reference to fire hazard assumes a standard city with deficiency charges for departure from the standard. The absence of a water supply is represented by a charge of 1,700 points out of the total possible deficiency points of 5,000 provided in the schedule. The major importance of water supply from the fire-risk standpoint is thus apparent.

Among the requirements for a continued supply of water are a dependable source, unbroken supply mains, and reliable pumping equipment. As these are all more or less likely to suffer damage in an earthquake region, special precau-

tions should be taken to insure their safety from injury and to provide auxiliary supplies for use in case of damage.

Sources of Supply

The communities of the metropolitan area of San Francisco are at present supplied entirely from local sources, partly from surface streams direct, but mostly from winter runoff held in storage reservoirs, or from wells. The principal agencies supplying water within the metropolitan district with the approximate amounts now being delivered to city distribution systems are as follows:

	Million Gallons Per Day
Spring Water Co. (w. and r.)	41
East Bay Water Co. (w. and r.)	30
Marin Municipal Water District (r.)**	6
San Lorenzo Water Co. (wells)	3.4
Peninsula Water Co. (w. and r.)	
South San Francisco Water Co. (w. and r.)	
City of San Bruno (wells)	
City of Burlingame (wells)	
Total	80.4

*Wells and reservoirs.
**Reservoirs.

San Francisco is supplied by the Spring Valley Water Company from storage reservoirs on the Peninsula and at Calaveras in Alameda County, together with the flow of Alameda Creek supplemented by wells in Livermore Valley. The supply, as now augmented by additional storage at Calaveras, is adequate for present needs.

In one respect, however, the present water system of San Francisco is incomplete. The volume of reservoir storage available within the city is inadequate, as it represents but three days' supply. In the event of damage to the long pipeline from the Peninsula or the main pumping plants by earthquake or other cause, a serious shortage of drinking water might occur within the city, which it would be difficult to meet. This is a situation which the City Engineer has pointed out in official reports and in public statements, but no action has been taken to remedy it.

Ample Fire Protection

The fresh-water distribution system in San Francisco, together with the auxiliary salt-water fire-protection system covering the congested-value area of the city, affords ample fire protection. The lessons derived from the earthquake and fire of April, 1906, have been incorporated in the high-pressure salt-water distribution system, and the latter represents one of the best of its kind. Special features are included which adapt it to earthquake conditions, one of which is the well-maintained system of cisterns located in portions of the city where distribution pipes may suffer damage by earthquake.

TABLE 1

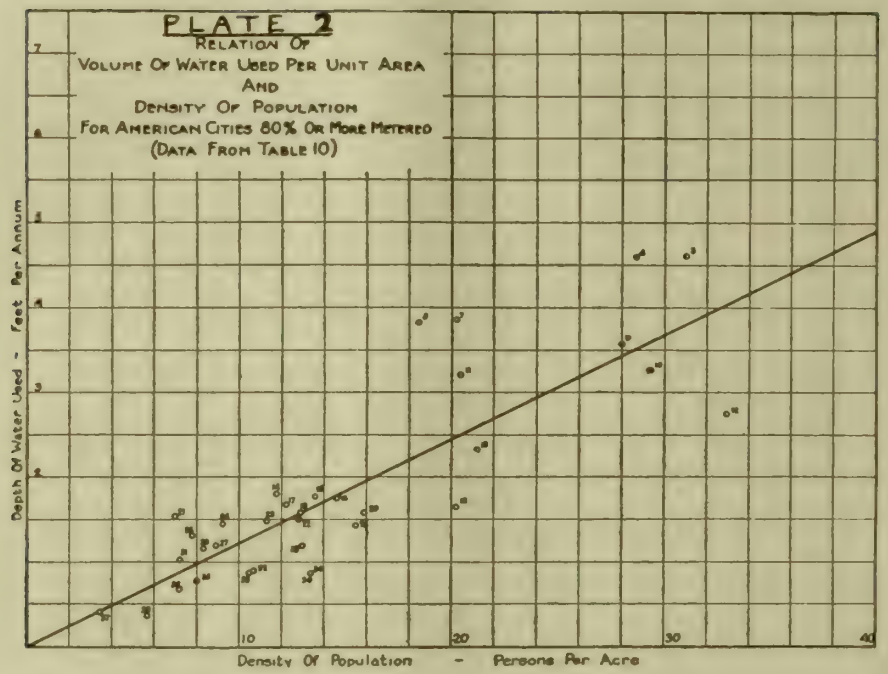
Volume of Water Used Per Unit Area and Density of Population for American Cities Eighty Per Cent or More Metered

No.	City	Estimated Population July 1, 1923	Land Area† July 1, 1923 Acres	Density of Population Persons per Acre	Average Daily Water Consumption, 1924 Million Gallons§	Water Use per Acre	
						Gallons per Day	Feet per Year
1	Chicago, Ill.*	2,886,971	124,604	23.2	806	6,470	7.25
2	Buffalo, N.Y.*	532,440	24,890	21.4	119	4,780	5.35
3	New York, N.Y.	5,927,625	191,360	31.0	789	4,120	4.61
4	Milwaukee, Wis.	484,595	16,885	28.7	69	4,090	4.58
5	Philadelphia, Pa.*	1,922,788	81,920	23.4	323	3,950	4.43
6	Baltimore, Md.	773,580	27,634	15.4	105	3,800	4.25
7	Cleveland, O.	888,519	43,929	20.2	151	3,440	3.85
8	Detroit, Mich.	995,668	54,175	18.4	184	3,400	3.81
9	Boston, Mass.	770,932	27,635	28.0	87.7	3,180	3.56
10	Newark, N.J.	438,699	14,913	29.4	43.6	2,920	3.25
11	St. Louis, Mo.*	797,219	39,040	20.4	112	2,870	3.21
12	San Francisco, Cal.	534,415	16,170‡	33.0	39.3	2,450	2.74
13	Providence, R.I.	242,036	11,410	21.2	23.6	2,070	2.32
14	Washington, D.C.	470,481	39,680	11.8	64	1,610	1.80
15	Hartford, Conn.	138,036	10,163	13.6	16.1	1,590	1.78
16	Toledo, O.	269,338	18,440	14.6	29.0	1,570	1.76
17	Los Angeles, Cal.	985,000	80,960‡	12.2	121	1,495	1.68
18	San Francisco, Cal.	534,415	26,880	20.2	39.3	1,465	1.64
19	Grand Rapids, Mich.	144,166	11,211	12.9	15.9	1,420	1.59
20	Columbus, O.	261,082	16,475	15.9	23.2	1,410	1.58
21	Santa Rosa, Cal.	9,098	1,311	7.0	1.25	1,375	1.54
22	Minneapolis, Minn.	409,125	31,834	12.8	42.8	1,340	1.50
23	Atlanta, Ga.	222,963	19,635	11.3	26.0	1,320	1.48
24	Kansas City, Mo.	346,598	37,395	9.2	48.3	1,290	1.45
25	Rochester, N.Y.	318,892	20,565	15.5	26.4	1,285	1.44
26	San Jose and adjacent towns—Cal.	80,000	10,281	7.8	12.0	1,170	1.31
27	Cincinnati, O.	406,387	45,598	8.9	48.9	1,070	1.20
28	Akron, O.	208,435	15,990	13.0	17.0	1,060	1.19
29	Yonkers, N.Y.	107,520	12,880	8.3	13.4	1,040	1.16
30	Seattle, Wash.	315,312	43,840	7.2	40.0	915	1.02
31	New Bedford, Mass.	129,861	12,153	10.7	9.7	800	0.90
32	East Bay cities, Cal.	498,000	37,000‡	13.5	29.4	796	0.89
33	Dallas, Tex.	173,696	16,539	10.5	13.0	785	0.88
34	Lowell, Mass.	115,089	8,566	13.4	6.5	765	0.86
35	Worcester, Mass.	191,637	23,782	8.0	16.3	685	0.77
36	St. Paul, Minn.	241,891	33,388	7.2	20.4	610	0.68
37	Vallejo, Cal.	24,629	3,282	7.5	1.50	608	0.68
38	New Orleans, La.	404,575	113,920	3.5	42.0	370	0.41
39	Fall River, Mass.	120,912	21,051	5.7	6.8	323	0.36

* Less than eighty per cent metered.
† Municipal boundary except as noted.
‡ Domestic service area.
§ Data from records published by American Water Works Association.

The nine East Bay cities are served by the East Bay Water Company. The supply is derived from storage reservoirs in the hills back of Oakland and Berkeley, and from wells along the shore of the Bay. With the recent rapid growth of the East Bay region and the long period of sub-normal rainfall extending over several years, this supply is no longer adequate. The East Bay Municipal Utility District is now actively engaged in bringing in an emergency supply from the lower San Joaquin River, and ultimately plans to extend its pipeline to a storage reservoir to be constructed on the Mokelumne River in the Sierra Nevada foothills. This system when completed should fully meet all local requirements.

Much of the built-up area of the East Bay region has not had adequate fire protection because of small distribution pipe capacities. Steps are now being taken partially to remedy this condition. A small capacity auxiliary salt-water system serves the congested value area of Oakland, but no other area is thus served. In case of a long interruption of flow through the main supply lines, due to a break or injury to pumps, a serious shortage of water for all purposes would occur. This is due to insufficient storage capacity at points within the service area, especially within the higher service zones. There are twenty-seven pressure zones, and pumping from main supply lines through equalizing reservoirs is required to serve the higher levels, as well as to maintain flow in the supply



lines themselves. In some instances water is pumped seven times before reaching consumers. Although the combined capacity of all reservoirs within the distribution system is sufficient to furnish nine days' supply, yet the actual supply in storage at any time is seldom up to full capacity. Furthermore more than eighty per cent of the capacity is represented by three reservoirs. Many of the pressure zones have barely a day's supply in storage, and, in case of serious crippling of pumping plants, would soon be without water.

The Marin County towns are well supplied by the Marin Municipal Water District, which obtains most of its water from storage reservoirs on the north slope of Mount Tamalpais. The District is developing its sources and extending its lines to meet all demands.

Situation on the Peninsula

Communities on the Peninsula, taken generally, are at present inadequately supplied with water, and are doing little to provide for the future. This region is building up rapidly, and is already beginning to feel the effects of inadequate water supply. Most of the towns draw their water from wells. The absence of normal replenishment of the underground supply from local rainfall and stream flow during the past eight years, combined with greatly increased drafts upon the supply, have caused the water level to drop many feet below the lowest stage ever previously experienced. The pumping level over large areas in some of the most highly developed portions of the Peninsula is nearly one hundred feet below the surface of the Bay, and in some districts exceeds this.

The varied demands upon the supply made by municipalities, industries, commercial agriculture, and private estates, have increased so rapidly the past few years that a return of normal winter rainfall will do little more than slightly retard the lowering of the water level. Conditions are rapidly approaching a point where the water-bearing gravels will either be completely drained to bedrock or pumping will become too expensive. In addition, there is the constant menace of salt water being drawn into the gravels from the Bay and rendering the water unfit for use. The date is past due in this area when definite steps should be taken to provide for future needs.

Many of the Peninsula towns have reservoir capacity for but a few hours' supply, and depend entirely upon pumps. In case of damage to pumping plants by earthquake, the supply might be cut off for a considerable period of time with serious consequences to the inhabitants.

Future Demand Discussed

The climate of the Bay region is almost semi-arid, rainfall being relatively small in amount and its occurrence confined to a few months of the year. Occasional years are also experienced when the rainfall is far below normal, sometimes several such years occurring in succession. The available natural water supply of the Bay region is therefore less than in humid regions, and more expensive to develop. The potential demand for water is also greater than in humid regions. This results from its greater use for domestic and municipal purposes, and its widespread use for home gardens and field irrigation. It is therefore important, in looking into the future of the Bay region, to ascertain the probable demand for water and its relation to the available supply.

The common method in use among hydraulic engineers for determining the future demand for water, is to analyze statistics of past daily per capita consumption for the community and similar communities comparably situated. This procedure, while satisfactory for single communities obtaining water from a common system, is not so well adapted to a metropolitan area including a number of separately served communities with diverse characteristics, as well as irrigated agricultural lands and industrial districts. For such areas it is more practicable to determine the volume of water

TABLE 2

City	Nature of Use	Depth in Feet of Water Used Per Annum
Los Angeles	City domestic system, whole service area	1.74
	City domestic system, original area of city	2.69
	Congested business district	24.36
	Industrial	1.67
	First-class residential	1.90
	First-class residential with large improved estates	2.14
	Second-class residential	1.61
	Third-class residential	1.35
	Suburban acre lots, poultry-raising	2.45
	San Fernando Valley, irrigation system	1.30
San Francisco	Spring Valley Water Co. system	2.74
Oakland, Alameda, Berkeley, etc.	East Bay Water Co. system	0.89
Palo Alto	City domestic system	1.04
Santa Clara Valley towns	City domestic system	1.31
Santa Rosa	City domestic system	1.05
Vallejo	City domestic system	1.10
Sacramento	City domestic system (ample and cheap supply)	2.54
Atherton	Domestic and irrigation on large improved estates	2.10

consumed per unit of area such as the acre, or the depth of solid water delivered to the area in a given time if accumulated upon the surface.

Analysis of statistics of general municipal use on the latter basis furnishes a more logical basis for comparison of the amounts of water used by different communities, and also gives opportunity for direct comparison with use for irrigation which is always expressed as depth applied to the land. The writer for a number of years has been studying the use of water from this standpoint. He has had available the large amount of water-works data which have been assembled in recent years through the activities of the New England and the American Water Works associations and other similar organizations. He has obtained also many data direct from water-works officials, and has drawn from his personal observations.

Consumption Yardstick Evolved

These studies indicate that for American cities in which eighty or more per cent of the water is metered, there is a direct proportional relation between density of population and annual depth of water delivered to the service area. The general rule was found to apply in both eastern and western cities. The basis for this conclusion is indicated graphically on Plate 2, which was prepared from data assembled on Table 1. As is to be expected, there are departures from the average line, but the general trend is unmistakable. Los Angeles, for example, with its low water rates and extensive use of water for ornamental grounds and house gardens lies above the average line, while San Francisco, with its high rates and absence of gardens is considerably below. Similarly, Milwaukee with an unusually large consumption of water for industrial purposes is far above the line, while St. Paul, whose demand is mostly for municipal and domestic purposes, lies below.

In order to have a definite yardstick for comparison, the following tabulation has been prepared from Plate 2, and may be considered as representative for the average American city eighty per cent or more metered:

GENERAL MUNICIPAL USE

Density of Population Persons Per Acre	Feet Per Annum of Water Used	Density of Population Persons Per Acre	Feet Per Annum of Water Used
5	0.60	25	3.05
10	1.22	30	3.67
15	1.83	35	4.30
20	2.45	40	4.90

Corresponding data for net delivery of water for irrigation of general crops in various parts of California, as adopted by the State Engineer after a review of all available data,[1] are as follows:

County	Use of Water Depth in Feet Per Annum
Los Angeles and Ventura	1.75
Santa Clara, San Mateo, Alameda, and Contra Costa	1.50
Marin, Sonoma, Napa, and Solano	1.25

The following table gives additional data for individual communities in California and for different uses of water. The figures are determined for the actual area covered by each distribution system:

An interesting conclusion to be drawn from the data above is that California cities such as Los Angeles, San Jose, Palo Alto, Santa Rosa, etc., which are predominantly residential in character, with a large use for irrigation of house gardens and beautified grounds, and having low or moderate charges for water, lie above the average line for American cities (Plate 2). The East Bay cities, although residential in character, are an exception, being below the average. This is probably due to the high water rates and past shortages in water supply which have impressed the habit of frugal use upon consumers. These cities would doubtless come up to the average if provided with ample water supply at lower rates. San Francisco is also considerably below the average, due in a large part to the absence of gardens from the homes and the large apartment-house population, as well as high water rates (see Table 2).

Los Angeles' Experience

The experience at Los Angeles has been that, as irrigated lands are subdivided and become built-up residential prop-

(Continued on Page 83)

[1] "Irrigation Requirements of California Lands," Bulletin No. 6, State of Cailfornia, Department of Public Works, Division of Engineering and Irrigation, 1923.

TABLE 3

Probable Ultimate Demand for Water, San Francisco Bay Metropolitan Area

Region	Acres Capable of Intensive Use	Population		Demand for Water	
		Per Acre	Total	Feet per Annum	Total Million Gallons per Day
North Bay Region					
Rural	312,700	2	625,400	1.25	231*
Urban-suburban	53,200	8	465,600	1.25	64
Sub-total	365,900		1,091,000		295
East Bay Region					
Rural	96,000	2	192,000	1.50	85*
Suburban and industrial	120,000	7	840,000	1.50	160
Urban	55,000	24	1,320,000	2.95	144
Sub-total	271,000		2,352,000		389
San Francisco					
Urban and industrial	21,900†	40	876,000	4.30	84
Peninsula					
Urban and industrial	37,500	16	600,000	1.95	65
Suburban	25,300	5	126,500	1.50	34
Sub-total	62,800		726,500		99
Santa Clara Valley					
Urban and industrial	20,000	12	240,000	1.50	27
Suburban and rural	135,000	3	405,000	1.50	180
Sub-total	155,000		645,000		207
Totals and average	876,600	6.5	5,690,500		1,074

* Thirty-three per cent of area deducted for dry farming and uncultivated land in determining water requirements; in other irrigated areas assumed uncultivated lands would be offset by losses in transmission systems and local storage.

† Golden Gate Park, Presidio, and roughest portions of Twin Peaks and Mount Davidson not included

STORAGE & DISTRIBUTION

Periodical Cleaning of Water Mains Saves Many a Bill for Replacements

Simple Cleaning Method is Tried with Considerable Success in Eastern Cities; Restores Carrying Capacity to within 5 Per Cent of New Pipe

By BURT B. HODGMAN, C. E.

EFFICIENCY of the underground water system involves two general topics. First the engineering study preliminary to the design, and after the design and installation, the up-keep, and the up-keep is just as necessary as the proper design. This up-keep or maintenance is most important to the safety of the community both for health and for fire protection.

If the future should develop science to the extent that instead of taking X-ray photographs of some of the unseen things, we were enabled to look into the earth and see the condition of the water system on which we have spent large sums of money, probably many superintendents would make haste to have them cleaned, but of course, out of sight out of mind controls this situation in many places, until necessity or the Board of Fire Underwriters appears. This board makes an examination and presto, the system is found wanting.

Whenever a large fire occurs in the city we frequently hear the report "lack of water pressure." What is this lack of water pressure? Usually it is nothing more than excessive friction due to corrosion or sediment in the mains which could be removed at a small cost.

Scale Reduces Capacity

What is the effect of the scale that is found in water mains? The first effect is reduction in the carrying capacity. Scale on the inside of the mains where the individual tubercles reach one-half inch in thickness will reduce the carrying capacity of 6-inch and 8-inch mains approximately 50 per cent or in other words you are getting one-half the value you would get if the mains were clean. Who would be content to get 7½ miles to the gallon with their automobile if at a small expenditure they would get 15 miles, but that is not all. When the Board of Fire Underwriters make their examination they say replace the 6-inch or 8-inch mains with 12-inch and 16-inch or perhaps larger or they will raise the premium rates of your insurance. Now in many cases if the present mains were kept in good condition there would be little cause for replacing or raising the premium rates.

OUT of sight, out of mind, is the way Mr. Hodgman describes the mental attitude of many water works engineers toward underground water systems—an attitude, he continues, that receives a severe jolt when dire necessity or the Board of Fire Underwriters intervene and call attention to lack of water pressure due to excessive friction from corrosion or sediment in the mains. The remedy then is not replacement, the writer asserts, but a thorough cleaning of the offending mains by methods found highly effective in many eastern localities, but little understood on the Pacific Coast. Mr. Hodgman, who is vice president and general manager of the National Water Main Cleaning Company, describes these methods in the accompanying paper, which was read at the Southwest Water Works convention at Shreveport, La., on October 12.

I know of one large city where the Board of Fire Underwriters laid out an extensive program for replacement in their heavy risk district and said if this program was not followed out their rates would be raised. Not one foot of these replacements was made, but they had my company clean the mains and after another examination they were given a clean bill of helth and no increase in rates.

Another Source of Saving

Another source of saving due to the cleaning of mains can be effected by reducing the power cost for pumping. An excess of friction in a pumping main increases the department's operation cost either in excessive cost of coal or other power.

Now what are the results from a sanitary standpoint? Investigation has shown that bacteria live and continue in sediment and scale in the mains in various places. When a city puts in a filtration plant and their mains are dirty, they seem satisfied to turn the clear water on and run it through these mains and so long as the water is clear everything seems to be satisfactory; but when there is a fire which creates increased velocity in the mains or perhaps changes the direction of flow, it stirs up the mud or scale and the citizens complain of the inefficiency of the filter plant while they may be getting bacteria also.

Cleaning Method Described

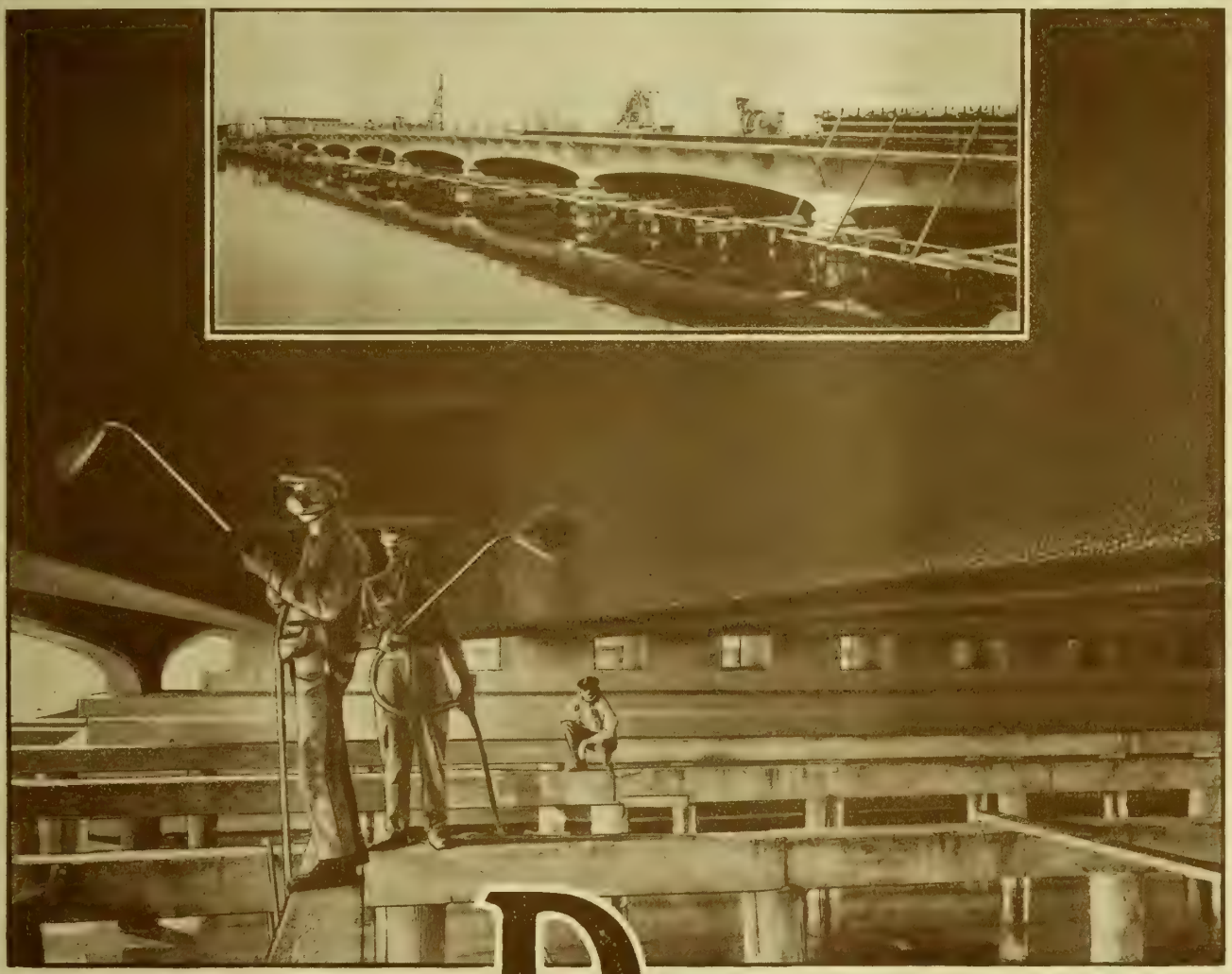
Several cities, when they have gotten a new water supply, have taken the precaution to clean out their entire system. This not only gives them adequate carrying capacity but cleans mains to transport potable water.

The method of cleaning is comparatively simple for those experienced in the art. It consists in cutting the main at two points, perhaps, 500, 1,000, or 1500 feet apart. In small mains a float is put through by the flow of the water and a cable is drawn through following the float. The cleaning machine is attached to the cable. This machine is pulled through the main with the water running to the riser pipe, giving the main a good flushing as well as scraping at the same time. The operation in larger mains is very similar except that no cable is needed because the machine is propelled by water pressure. Experience has taught us how to scrape mains to a degree where all of the foreign matter is removed but none of the tar coating is disturbed by the process.

Restore Original Capacity

We can guarantee to restore the carrying capacity of any main, which has originally been tar coated, to within 5 per cent of that of new pipe, but actually we restore the original carrying capacity of the main. The 5 per cent allowance is not for any dirt left in the main but is for irregularities of laying, special fittings, corporations cocks extending into the mains, etc.

A great deal of experience is required to learn this art as we know only too well. We have a force of superintendents who have been with us from eight to twenty years doing nothing but this type of work. We feel, therefore, that we are eminently qualified to meet every situation which comes up in water main cleaning and by our experience we have saved many cities a large outlay for replacements and for coal to pump against excess friction.



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For Detailed Listings See the Western Buyers' Guide of Waterworks Equipment—Pages 75-76

How San Diego Plans Its Water Supply

(Continued from Page 37)

well under way, consists of the construction of the so-called El Capitan pipe line, originally designed to extend from the University Heights Reservoir, the central distibuting point of the city's system, some twenty-five miles easterly to El Capitan Reservoir. The present construction contemplates the completion of the line as far as Lakeside, a distance of approximately seventeen miles. This line is to be 36-inch Lock Bar steel pipe, buried at all places except where it is carried on supports over coulees and across canyons, and equipped throughout with the latest type of appurtenances. All of the concrete piers have now been completed, and a substantial part of the trench work is finished.

Irrigation Water

Realizing the desirability of encouraging all possible farm development in the vicinity of San Diego, as well as in the entire county, and in order to promote a spirit of cooperation and harmony with the people of Riverview, the city has agreed to sell irrigation water to all land owners whose water supply may be in any manner impaired by the operation of the city's pumping plant. Future development by the city, therefore, will have the effect of insuring a bountiful water supply to the farmers, at all seasons of the year. At the same time the lowering of the water table and consequent improvement in under drainage will materially enhance the value of the land.

In connection with this development a filter plant, having a capacity of at least ten million gallons daily, will be installed at or near the booster pumps. The design of this unit will be such that it can be readily enlarged to handle all water ultimately developed about Riverview.

Further Dam Sites

Careful and lengthy consideration of many factors, and of a vast amount of data bearing upon the situation, conclusively indicates the most logical undertaking under the circumstances to be the construction of a dam at the Sutherland site, a conduit to carry the water from Sutherland Reservoir to San Vicente drainage, a diversion dam to take the water out of San Vicente Creek at Foster and a pipe line to connect the diversion dam with the El Capitan pipe line at Lakeside.

The available finances will permit constructing Sutherland Dam to its ultimate height and building the necessary conduit and other works, so that water can be at once conveyed through the connection with El Capitan pipe line into the University Heights Reservoir.

Therefore, instead of waiting upon the settlement of legal matters pertaining to the El Capitan development and the additional time required for the construction of the El Capitan Dam, or waiting until there are sufficient funds to undertake the construction of both Sutherland and San Vicente Dams, it appears most advisable to follow the program as indicated in the foregoing.

The development at Sutherland contemplates a dam approximately one hundred and sixty feet high. Some of the best known designers of dams in the country, such as Lars Jorgensen, Fred A. Noetzli, the Ambureen Dam Company, and others, have been called upon for designs; and, to insure the selection of the most economical, feasible and substantial structure, Arthur P. Davis, formerly head of the United States Reclamation Service and now Chief Engineer of the East Bay Municipal Utilities District at Oakland, California, has been retained, in a consulting capacity, to advise with the city officials in the selection of the most economical type of structure.

Carrying on as we are and up to the time San Vicente Dam is built, it is estimated that the city's water supply will be increased by approximately 6.0 m.g.d., which will then bring the total safe net yield up to 22.47 m.g.d.

At the close of the "ninth period of development" (1930-1931) the net safe yield of the city's supply should be 43.97 m.g.d., while at the end of the last period considered in the planning, 1931-1940) the total supply available would be 53.97 million gallons daily.

In conclusion, it seems pertinent to mention that, besides a definite program, hereinabove outlined, the city is constantly conducting studies and securing data relative to a number of other possible reservoir sites and water supplies. Long before the present program is carried to completion plans for further additions to the city's water system will have been perfected.

Mention may also be made of the well known and much advocated Colorado River development, which contemplates a water supply that will be available to all Southern California. Needless to say, San Diego officials are actively interested in this enterprise and are taking all steps necessary to safeguard the city's rights and interests.

Owing to the magnitude of the developments under way and contemplated, and to the importance of the work involved, a separate bureau has been organized to handle all matters pertaining to the city's water development program. The bureau is known as the Department of Water Development, Robert F. Cowles being the engineer in charge and Geo. B. Archibald being assistant engineer. Acknowledgment is duly made this department for the preparation of the preceding article and for the compilation of the several maps, charts and diagrams presented herewith. It is also desired to acknowledge the hearty cooperation and valuable assistance of R. C. Wueste, for many years supervisor of the city's impounding system, in furnishing operation data and other records of importance.

Review of California Section

(Continued from Page 15)

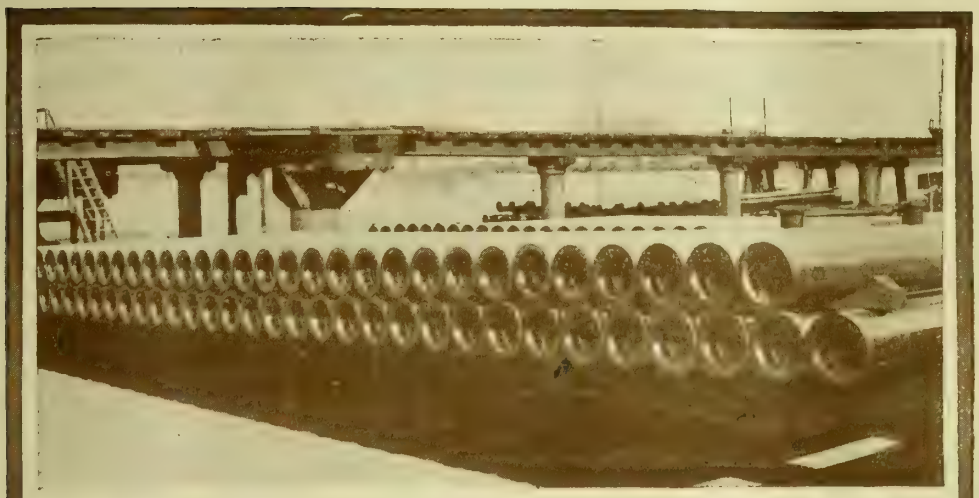
mund K. Barnum, engineer of the Fresno City Water Corporation, told the association about the Fresno system. Problems of design and distribution were discussed by George Read, of Los Angeles, in his paper on "Proper Arrangement of Plumbing for Buildings Higher Than Can Be Adequately Served Direct from Distributing System"; by J. E. Phillips, also of Los Angeles, who spoke on "Use of Balancing Reservoirs in Water Distributing Systems," and by Louis Stocklmeir, engineer, Pacific Board of Fire Underwriters, on the "Effect of Distributing Design Upon Fire Insurance Rates." S. B. Morris, of Pasadena, read a paper on "Types of Pipe and Water Main Construction," and R. L. Daugherty, professor of Mechanical Engineering and Hydraulics, of the California School of Technology, spoke on "Water Measuring Devices."

For those whose special problem was sanitary engineering, Dr. Carl Wilson, bacteriologist of the Los Angeles Bureau of Water Works and Supply, read a paper on "Reasonable Water Sanitation Requirements," and Gale S. Strout, Consulting Engineer of San Francisco, spoke on "Softening of Public Water Supplies." Charles Gilman Hyde gave an interesting recital of some of his European experiences, and Al C. Joy, publicity manager of the San Joaquin Light and Power Corporation, spoke on "Public Relations."

Officers were elected as follows: Chairman, Fred J. Klaus; Vice-Chairman, George W. Pracy; Secretary-Treasurer, S. B. Morris; Members of the Executive Committee, C. B. Jackson and P. Diederich, superintendent of the Public Service Department, Glendale.

Last Year's Meeting

Last year the California section met in its sixth annual convention at Santa



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—is now ready to ship in sizes from 4″ to 20″

The principal features of deLavaud Centrifugal Pipe are:

1—Lower cost per foot.
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3—An even greater resistance to corrosion owing to its finer granular structure.
4—Cheaper to install owing to its uniform lead space and self centering bell.
5—It is easier to cut and tap.
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9—Annealing gives a uniform metal with no casting strains.
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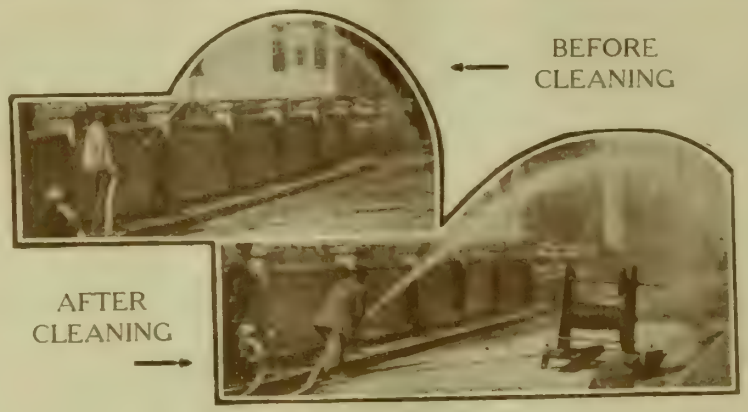
New York: 71 Broadway
San Francisco: 3rd & Market Sts.
Pittsburgh: 6th & Smithfield Sts.
Dallas: Akard & Commerce Sts.
Kansas City: 13th & Locust Sts.

For Detailed Listings See the Western Buyers' Guide of Waterworks Equipment—Pages 75-76



Taking a National Treatment

THIS sounds much like a patent medicine advertisement. Why shouldn't it, for the National Water Main Cleaning Company has the remedy for inefficient water mains.

If the above 6-inch line could testify it would say that its carrying capacity had been increased three times after the many cubic feet of incrustation had been removed from its interior.

Let the NATIONAL METHOD doctor your municipality's sickly mains.

Ask for further information

National Water Main Cleaning Company

50 Church Street New York City, N. Y.

"Twenty Years of Successful Water Main Cleaning"

Roscoe Moss Company
Well Contractors

We are completely equipped to drill wells of any desired size or depth. Our rigs operate throughout the Southwest. Headquarters for well supplies; rental tools.

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Cruz, on October 15, 16, 17. An attendance of 247 interested delegates from all parts of the state, combined with the excellent program, made the occasion a notable one. One of the most interesting features was the presentation of the Nicholas S. Hill cup, an annual award offered by a former president of the American Water Works Association to that regional section which has shown, during the year, the greatest growth in membership. F. M. Randlett, National Director of the A.W.W.A., attended the convention for the purpose of presenting this trophy to the California section, but the cup had been mysteriously mislaid in transit, and when every effort to locate it failed, Mr. Randlett made a graceful presentation speech, congratulating the Section upon its growth, and urging the organization to still further expansion, and awarding the cup as a recognition of the 1925 record—although no cup was at hand. The secretary reported that during the year twenty-eight members were added to the Section, of whom 22 were active, 2 corporate, and 4 associate members, bringing the total membership of the organization to 125.

Three Symposiums in 1925

The 1925 program was marked by three symposium discussions: "Service Installation Methods and Standards," "Meter Maintenance Methods," and "Jointing Methods for Water Mains." One of the noticeable features of these discussions was the freedom with which the delegates participated, exchanging experiences and comparing notes without restraint. The various papers read were noted for their practical ideas and the clearness with which they were treated. New officers elected for 1926 were: Chairman, C. B. Jackson; Vice-Chairman, S. B. Morris; Secretary-Treasurer, Paul E. Magerstadt, designing engineer, East Bay Water Company, Oakland; Members of the Executive Committee, John Burt and P. Diederich.

The great value of the organization, according to the members who have given their opinion, is that above all it has given an opportunity for the water works men to get better acquainted, to trade ideas and solutions to problems. As George W. Pracy expressed it, "These early meetings have given the waterworks men of California an opportunity to learn new tricks, to gain by the experience of others, to take action when necessary for the good of the business as a whole, and to work out plans for standardization which will benefit both the manufacturers and the buyers. If the association will continue to help the individuals in the waterworks business, I feel sure that it has ahead of it a long and useful life."

To prevent Corrosion, Tuberculation, Electrolysis

Corrosion-proofing in the Hetch Hetchy Water System with Biturine Enamel

DUMBARTON Aqueduct over S. F. Bay, a part of the Hetch Hetchy, the largest Water System in this country. Here the corrosive tendency of salt air and salt water had to be overcome. Both the steel bridge and the pipe line have been coated with Biturine Enamel.

BITURINE was also used extensively in other parts of the Hetch Hetchy project, including (as completed to date) 20 miles of 60″ riveted steel pipe, ¾ mile 42″ cast iron submarine pipe, and the penstocks of the 100,000 H. P. Moccasin Creek Power House, the largest hydro-electric plant in the world.

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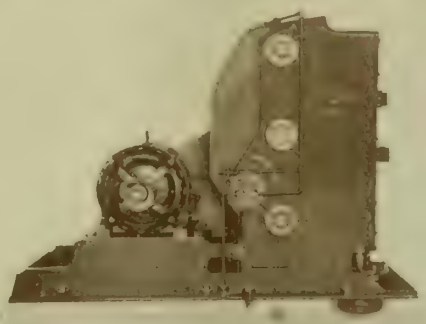
Announcing the Greatest Forward Step in Recent Years in

DEEP WELL PUMPS

FOR CAPACITIES UP TO 500 GALLONS PER MINUTE



THE COOK OVERLAPPING TWO-STROKE SELF OILING DEEP WELL HEAD

Every feature desirable in a pump of this character is incorporated in this pump.

Perfect Balance	Foundation easily Constructed	Running in Oil
Low Center of Gravity		Massive Pump Frame
Low Head Room	Highest Quality of Workmanship	Forms Oil Retaining Casing
Quiet Running		
Rigid Pump Base	Compactness	No Uneven Wear
No Pump Pit	Overlapping Stroke	Accessibility to Well Parts

THRUST ON CROSS HEAD GUIDES PRACTICALLY ELIMINATED.
ALL SHAFTS IN REMOVABLE BRONZE BUSHINGS.
DISCHARGES IN ANY DIRECTION.
BUILT IN 5 H. P., 7½ H. P., 10 H. P., 15 H. P. and 25 H. P. SIZES, each designed to operate continuously when receiving the full output of a 40 degree Centigrade Motor of corresponding size.
Driven by any convenient form, or combinations of forms of power.

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Manufacturers of
DEEP WELL PUMPS—COOK PATENT BRASS TUBE WELL STRAINERS—
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A Call from one of our Representatives or one of our Bulletins may prevent your buying an obsolete pump

With the California Railroad Commission

Will Operate Domestic System

E. J. Whitney has applied to the California Railroad Commission for a certificate to operate a domestic water system in Tract 4782, Los Angeles County.

Pomona Will Take Over System

Consolidated Water Company of Pomona, California, has applied to the Railroad Commission for permission to sell its water system to the City of Pomona.

Grants New Rate Schedule

Fay Water Company, operating in the vicinity of Port San Luis, San Luis Obispo County, has been authorized by the California Railroad Commission to establish a new schedule of rates sufficient to permit proper maintenance of the plant.

Grants Maturity Date Change

In a supplemental order the California Railroad Commission today authorized Los Angeles Water Service Company to issue $385,000 of its six and a half bonds, maturing August 1, 1946, instead of June 1, 1946, as originally authorized.

Seeks to Issue Bonds

Roseville Water Company has applied to the California Railroad Commission for authority to create a bonded indebtedness of $200,000, and to issue and sell $180,000 of such bonds for the purpose of financing additions and betterments and to refund outstanding bonds.

Asks to Renew Loan

San Dimas-Charter Oak Domestic Water Company has applied to the California Railroad Commission for permission to renew a loan of $10,000, and issue notes to the San Dimas Water Company for $15,000 with interest at 7 per cent per annum, for a period of three years.

Asks Permit for System

H. T. Robinson, operating under the name of Ocean Park Heights Land and Water Company, has applied to the Railroad Commission for a certificate authorizing him to exercise a franchise to operate a public utility water system in the territory between Culver City and the Venice district of Los Angeles.

Authorizes Amended Mortgage

North Sacramento Light and Water Company has been authorized by the California Railroad Commission in a supplemental order to execute an amended mortgage and/or deed of trust guaranteeing payment of $60,000 of first mortgage six and a half per cent gold bonds heretofore authorized by the Commission.

Asks Meter Rates

Thomas Parkhill, operating a domestic water system in the Ridge Park Tract, Contra Costa County, has applied to the California Railroad Commission for permission to establish meter rates and for the Commission to prescribe its uniform Rules and Regulations for water service, and the limits of the service area of that utility.

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No-Ox-Idized Wrapper

Guards Pipe Lines Against Rust

Millions of feet of pipe have been protected against rust in the last twelve months by NO-OX-ID. Photos show the simple inexpensive method of obtaining the most lasting protection known.

Chemical and mechanical rust protection are provided in NO-OX-ID. Both are absolutely essential to worth while results.

Dope and wiper crew applying NO-OX-ID ahead of wrapper gang. This crew of four men will average 5000 feet per day on 16″ pipe.

Follow-up crew of three and coupler dope man with lowering gang putting on sheet of wrapper and coupler sheet when skid removed.

3-man wrapper crew, applying NO-OX-IDized Wrapper and dope gang. Cross-lap laid on 16″ Dresser coupling line, 6 crews, 3 men to each. Averaged 4800 feet per day, or 800 feet per crew.

Lowering crew on 16″ line. The old saw "Out of sight, out of mind," only is safely true where NO-OX-ID and NO-OX-IDized Wrapper afford protection

No-Ox-Idized Wrapper Dresser or Welded Pipe

Cross Lap Laid Method recommended for Pipe Sizes 12″-22″

Size Pipe		[A]12″	[B]14″	[B]16″	[B]18″	[B]20″	[B]22″
Width of Cuts		35″	35″	35″	35″	35″	35″
Length of Cuts		44″	48″	54″	60″	67″	73″
Longitudinal Lap		2″	2″	2″	2″	2″	2″
Cross Section Lap		4″	4″	4″	4″	4″	4″
No. 100 Yard Bolts	"C"	22½	24	27	30	33½	35½
Pounds NO-OX-ID	"D"	880	1095	1245	1365	1575	1650

A. Inside Diameter.
B. Outside Diameter.
C. Allowance for Dresser Coupling Cover.
D. Average temperature conditions spread per pound or gallon 130 to 160 square feet.
Cost per mile material and labor, 4½%, total costs of installation complete.
An insurance on your installation against deterioration.

Our products serviced by experts. Correspondence invited.

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WOOD Pipe for irrigation—water works, sewers, etc., made in sizes from 2 in. to 14 ft. diameter. Made of California Redwood or Douglas Fir. Not affected by acids, salts or alkali. Let our engineers solve your problem.

Write for catalog and prices

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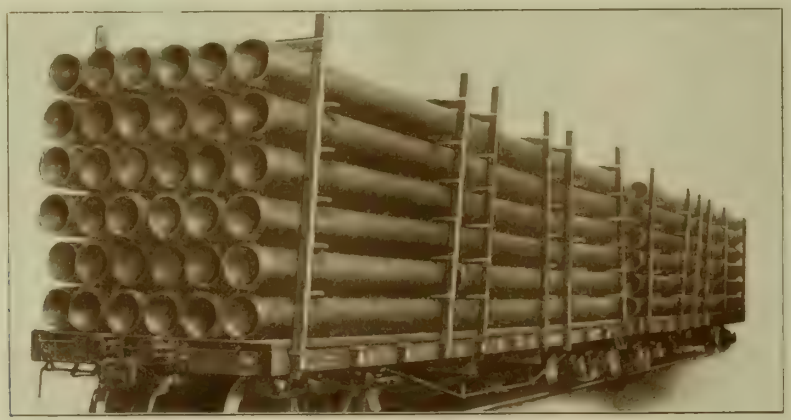

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McWANE CAST IRON PIPE CO.

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Manufacturers of Cast Iron Pressure Pipe

District Sales Office 422 Central Bldg. Los Angeles, Calif.

Must Cut Officers' Salaries

Los Altos Water Company has been authorized by the California Railroad Commission to establish a new schedule of rates sufficient to meet maintenance and operating expenses, depreciation annuity, and a reasonable return on its investment under existing circumstances, providing that the allowance for salaries of its officers is substantially reduced.

Will Sell Land for Pipe Line

Port Costa Water Company has applied to the California Railroad Commission for authority to sell to East Bay Municipal Utility District a strip of land 100 feet wide beginning at Bates avenue in the Government or Gwin ranch and extending 2417.3 feet to Tormey avenue to be used as a right of way for a pipe line and other work of the Utility District, for the sum of $5,250.

Sells Plant at San Juan

Aaron Buchheim, operating a public utility water plant in the townsite of San Juan-by-the-Sea, Orange County, California, under the name of Buchheim Water Company, has been authorized by the Railroad Commission to sell and transfer said system for the sum of $15,000 to San Juan Water Company, and the latter company has been authorized to issue and sell at par, for cash, three shares of its capital stock of the aggregate par value of $300, and use the proceeds to pay organization and incorporation expenses.

Acquires Deer Creek Reservoirs

Nevada Irrigation District, comprising upwards of 200,000 acres of foothill and valley lands in Nevada County, has applied to the California Railroad Commission to fix the compensation to be paid Pacific Gas and Electric Company for the acquisition by the district of the so-called Deer Creek reservoirs and water ditches of Pacific Gas and Electric Company.

As the result of informal negotiations conducted by the Railroad Commission between the two principals, the utility company agreed to sell its water works to the district when organized, which proposes to extend an irrigation system throughout the territory of the district, thereby bringing under cultivation a large area of productive territory now without adequate water service.

Orders Service Restored

After an investigation into the operations of a public utility water system operated by E. L. McCapes in the town of Raymond, Madera County, the California Railroad Commission has ordered McCapes to reconnect and resume service to the premises of T. M. Nicolas, whose service has been discontinued by McCapes. Evidence produced at the hearing conducted by the Commission showed that service to Nicolas was discontinued by McCapes without warrant, despite the fact that Nicolas had been served continuously for twelve years. Nicolas appealed to the Railroad Commission for relief and the Commission directed McCapes to restore service to Nicolas pending an investigation. McCapes having disregarding the Commission's instructions the Commission began an investigation on its own motion with the result that a peremptory order to McCapes to restore service to Nicolas, was issued.

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WHY LUITWIELERS FOR WATER WORKS?

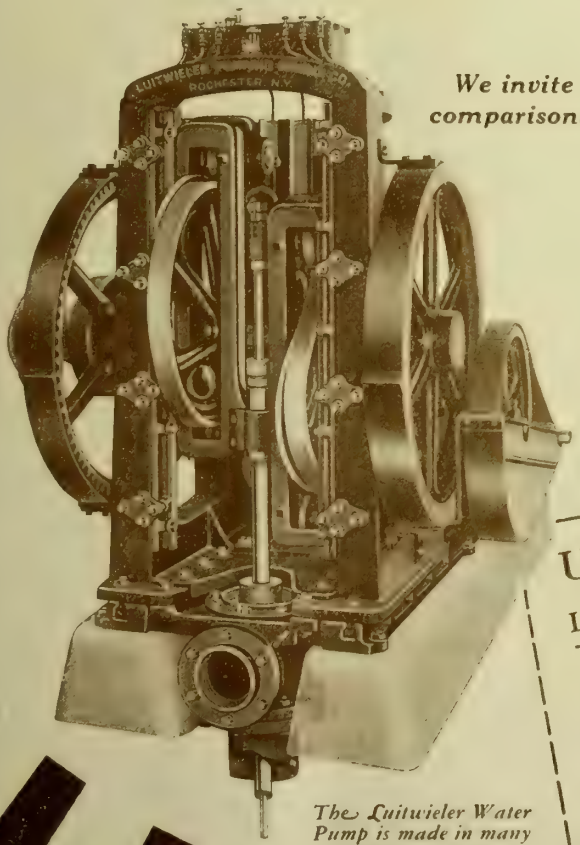
WE have a message of prime importance to water companies furnishing water to municipalities and communities, as well as to cities and towns developing their own supply.

Because first, the Luitwieler Pump, unit against unit, has no equal for efficiency-and we say this with full regard for the many good pumps on the market. And second, because water profits are the difference between water costs and the selling price regulated by the State. Every expense item lowered or eliminated makes this difference greater.

Mailing the coupon below can be the first step in adding to your revenue.

We speak with the authority derived from fifty years of pump experience.

Our engineers are at your service without obligation of any kind.



We invite comparisons

The Luitwieler Water Pump is made in many Sizes and Types

LUITWIELER PUMPING ENG. CO.
707 North Main Street
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USE THIS COUPON!

Luitwieler Pumping Engine Company,
707 North Main Street, Los Angeles, Calif.

Gentlemen: I want to know more about the Efficiency and Economy of the Luitwieler Pump. It is understood that there is no obligation.

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NON-PULSATING DOUBLE ACTION

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WATER PUMPS

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METERS & METERING

How the Los Angeles Water Department Is Solving Its Meter Problems

An Article That Discusses Many Phases of the Subject, Including Testing, Methods of Setting, and Repairing; Policy of Fairness to Users

By GEORGE READ*

WHILE anyone who follows the subject closely will agree that details of meter design and general practice do change with some frequency, it is possible there are not so many in the profession who realize that the basic principles of design and practice have remained practically unchanged for many years.

This fact was impressed on the writer not so long ago when he brought down from the files a paper on metering in Los Angeles that he had read before one of the early conventions of the California Section of the American Water Works Association. A rereading of the paper brought the realization that it was as up-to-date as though written the day before.

Of course, Los Angeles, which has established a world's record in its remarkable growth in population, has had and will continue to have its metering problems; but these, for the most part, are of a superficial nature, and the municipality, which purchased the properties of the old City Water Company back in 1902, can be said to have established a meter policy that might well serve as a model for other communities in the west. A discussion of some of the practices of the Los Angeles Bureau of Water Works and Supply might prove of interest to readers of this department of WESTERN WATERWORKS.

Store room and meter repair department of the Los Angeles Bureau of Water Works and Supply. The city uses several types of meters, two or three of which are shown in the foreground.

High Per Capita Use

Los Angeles always will have a higher per capita consumption than most eastern cities on account of its being a city of lawns and shrubbery which need watering about ten months out of the year. This per capita referred to covers metered services only. There is considerable water used outside of these for street washing and flushing, etc., and today this combined is estimated to make an average daily per capita consumption of 130 gallons, and reaches a high peak at times of 160 gallons. Due to the increase of apartment houses the number of consumers per service today is about 5.4.

During the first five years of public ownership of the water works, the city purchased several makes of meters, and from knowledge gained during this time the first set of specifications covering water meters for the city was written in March, 1907. From then on specifications have always been written and every improvement that would be advantageous to the city in prolonging the life of the meter has been embodied in these specifications.

In March, 1908, the Department purchased two 5/8 inch meters of all the different makes that could be had, and commenced a durability test. (The reason of the 5/8 inch size being chosen is that about 81% of the meters in service are of that size.) These meters were thoroughly tested before placing for the test, on two flows, one at the rate of two cubic feet per minute, and one at the rate of ten cubic feet per hour. They were then run steadily, night and day, at the rate of one cubic foot per minute, one-half their rated capacity. This rate was chosen so that no manufacturer could claim that the meters were being run beyond their rated capacity.

Test Took Over 2 Years

When the meters reached a registration of 25,000 cubic feet, they were taken off the line and again tested on the two flows, two cubic feet per minute and ten cubic feet per hour. The next test was made at 50,000 cubic feet recorded, the next at 75,000, and so on until the meter reached a registration of one million cubic feet. The meter was then taken off the line, ovehauled and made practically as good as when new. All the parts, etc., that were necessary to make the meter practically as good as when new plus the parts, etc., that were needed to keep the meter running to reach a registration of one million cubic feet, were charged up to the meter.

It took about two and one-half years to complete this test, and by means of it several weak spots were overcome. A meter under this kind of a test does not show the effects of corrosion as it would have if it had been in actual service, because water passing through the meter continuously tends to retard corrosion. Also the wear throughout the meter is not as great as if it had been in actual service, because the meter is running continuously at a steady pace and not subjected to hydraulic shocks through

*Superintendent Meter and Service Department, Bureau of Water Works and Supply, Los Angeles.

"Save the Surface and You Save All!"

EVERY Superintendent should keep this slogan in mind when buying water meters.

A thick, durable coat of tin protects the surface — external and internal — of every Hersey Domestic Water Meter. This protective coating is applied by dipping meter parts in a molten bath—not by the cheaper process of electro-tinning. It adds years of life to Hersey Meters. It is another proof of Hersey quality.

A Balanced Disc Piston which eliminates friction and accounts for the almost perfect accuracy of Hersey registration is another feature only to be found in Hersey Meters. These details of construction are of vital importance when you come to invest in new equipment.

Hersey Manufacturing Company, South Boston, Mass.

HERSEY
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NEW YORK, N. Y., 290 Broadway
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PHILADELPHIA, PA., 314 Commercial Trust Bldg.
ATLANTA, GA., 610 Citizens & Southern Bank Bldg.
DALLAS, TEX., 2301 Griffin Street
CHICAGO, ILL., 10 So. LaSalle St.
SAN FRANCISCO, Cal., 690 Market St.
LOS ANGELES, Cal., 450 East Third St.

Main Office and Works: Corner E and 2nd Sts., South Boston, Mass.

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turning off and on all the time.

All the makes of meters were working, however, under the same conditions, and the showings made were quite different in some cases. We consider that the knowledge gained paid well for the time and trouble and today we are still testing the same way.

Disk piston meters are used from ⅝-inch to 2-inch inclusive. For large office buildings, etc., requiring 3 and 4-inch meters, where the consumption as a rule is steady and where sensibility is the important factor, an oscillating piston type of meter is used. So far this type of meter has given the city the best service for this kind of use. It is expensive but dependable. Large services for fire protection, supplying only sprinkling systems, are not metered.

We consider it an imposition upon the consumer to install at his expense a large costly meter which might do harm and certainly do no good as far as the consumer is concerned. We insist on the piping from fire services being entirely separate from the domestic supply and we endeavor to inspect these services yearly, by shutting off the domestic supply and going through the premises. If we find water anywhere, it must be coming from the fire service. To date we have found only one case where this was really abused, and in that case the department imposed a pretty stiff penalty.

We are at this date strongly contemplating the use of check valves equipped with a regular 5-8-inch meter on a by pass for dection purposes on account it has become difficult, expensive and inconvenient to shut off the Domestic supply of a large building to make an inspection.

Services supplying sewer flush tanks are being metered with Jet meters as fast as time and funds will permit. We have 6841 of these connections, including San Pedro, and at this date 3948 are Jet metered.

The water is discharged into the tank through a hard vulcanized rubber disc and is calibrated to discharge as nearly as possible 300 gallons in twenty-four hours. It is impossible to make the calibration perfect for this amount in a given time, due to pressure variation.

There are several good water meters on the market today and, in fact, all meters are better than they were a few years ago.

As we are not bothered with freezing, our meters as a rule are set just inside the curb. They are placed on a riser from the service so that the face of the register is about 3 inches from the surface. This makes the reading of the meters and the changing of inactive meters, etc., easy and quick, and it also allows the use of an inexpensive shallow meter box.

New meter repair shop of the meter and service department, Los Angeles Bureau of Water Works and Supply. The view shows a close-up of several types of meters used by the city, which up to this time has not standardized on any one type, experience having proven that certain types are more suitable for certain installations than they are for others.

We have a local building ordinance which prohibits basements under sidewalks extending further than 3 feet from the curb. This strip was reserved by the city for the installation of fire plugs, meters, electrical conduits, and other public utility equipment.

We have a few meters in basements where the basement extends to the curb. These basements wer made prior to this ordinance. The few that we have are a nuisance. The meter-readers must get permission to enter, hunt keys and carry flash lights. Stuffing boxes are likely to leak and to cause damage. There is also a likelihood of a meter bursting and causing a great deal of damage.

When a large service must be metered in a basement we prefer a battery of 2-inch all bronze meters with valves governing the inlet and outlet of each meter. We consider a 2-inch all bronze meter not near as likely to burst as a 3 or 4-inch meter with main casing made of cast iron. In addition, if one meter stops operating it can be changed without shutting off the entire supply. Batteries have advantages and also disadvantages.

On services supplying large industrial plants, where at times it would be inconvenient and costly to the consumer to have the water cut off while changing the meter for repairs, we place a valve on each side of the meter and run a bypass pipe equipped with a valve around the two valves governing the meter. The bypass valve is left closed and sealed and when it is necessary to change the meter for repairs, etc., we open this bypass valve and then close the two valves governing the meter, thereby not interrupting the service.

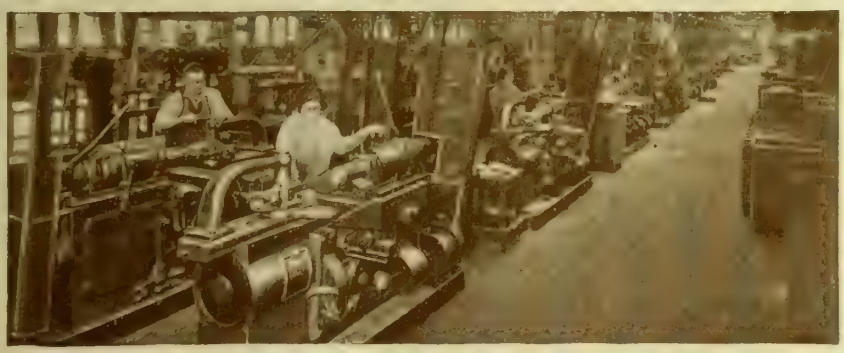
For covering meters in parkings, lawn or no lawn, a cement meter box 9 inches square by 11½ inches deep, is used—what we call our No. 1 meter box.

This box does not cover the curb cock and in fact we try to discourage the using of curb cocks by the consumer and recommend that they have a wheel valve placed by a plumber to control their water supply in case of needed repairs to leaky fixtures. The reason we try to discourage the consumer from using the curb cock is that in many cases they ruin them and frequently leave a hole dug out in front of the meter box which is a menace to the public.

We have specifications covering our curb cocks from one-half to 2-inch and they are standard all over the system. If any curb cock has to be renewed the space for the setting of the meter is retained. We also have a standard (fool proof) locking device for our curb cocks. By fool proof we mean that no curb cock can be clamped and sealed unless it is closed. Just before the world war broke out we were intending to cover meters in well kept lawns with a concrete meter box large enough to cover meter and curb cock both, and we still

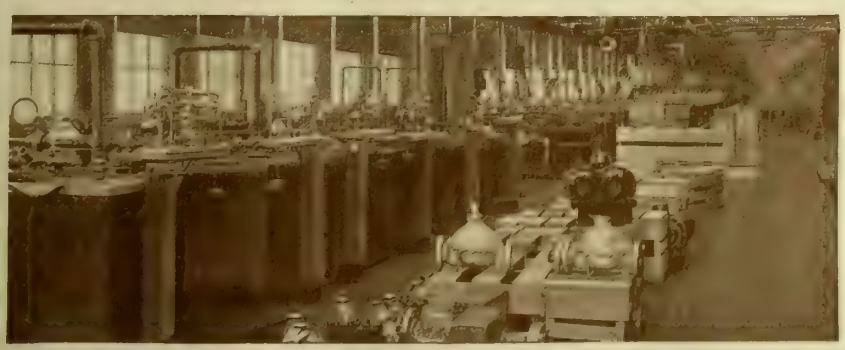
WORTHINGTON

A meter department ¼ mile long

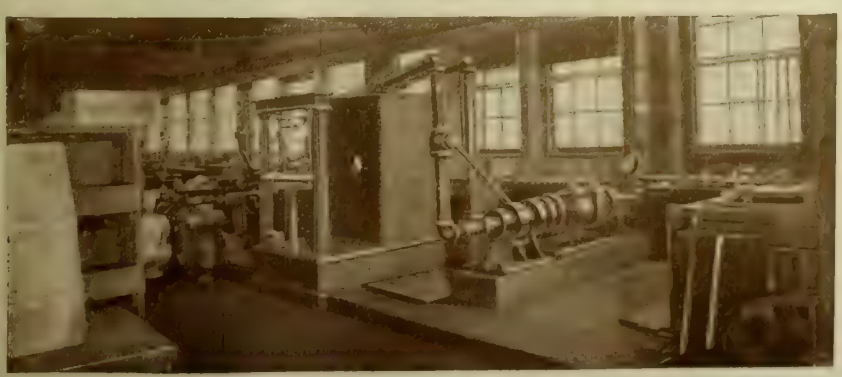


Turning brass parts for Worthington Meters

Large Meter Assembly Department



Small Meter Testing Department



Large Meter Test Stand

AN entire section — ¼ mile long — of Worthington's Harrison [N. J.] works is devoted exclusively to the manufacture of meters of all kinds.

That the demand for Worthington meters has necessitated a meter department of such extensive size is an indication of the widespread preference for Worthington Meters.

Stocks of meters and parts are carried in our branch houses in all parts of the country to insure prompt service.

Pumps
Compressors
Condensers
Oil and Gas Engines
Feedwater Heaters
Water and Oil Meters

WORTHINGTON PUMP AND MACHINERY CORPORATION
115 BROADWAY, NEW YORK CITY
BRANCH OFFICES IN 24 CITIES

7131-8

For Detailed Listings See the Western Buyers' Guide of Waterworks Equipment—Pages 75-76

intend to do this in the near future.

For housing meters set in cement walks we use a concrete well and a cast iron plate, large enough to house the meter and shut off. A wooden form made from 1x12 R. O. P. rabbited ¾x¾ is set in position and concrete poured around it. The plate then rests on the wooden form while the concrete is setting. Three sizes of plates are generally used as follows:

For covering ⅝ to 1-inch meters, the plate is 23½x15¾ inches, weighs 60 pounds and costs at this date $2.89 each. For covering 1½ and 2-inch meters, the plate is 30x22 inches, weighs 121 pounds and costs $4.35 each. For covering 3 and 4-inch meters, the plate is 46x26 inches, weighs 180 lbs. and costs $7.15 each. We also have a large plate, 64x26 inches, which we use at times to cover a fire-service gate and domestic meter.

When a sidewalk is being extended to the curb, taking in small concrete meter boxes that do not cover the curb cock, the Department requests the contractor to leave the top of the boxes level with the surface of the new walk and cement around them. Later on when the walk is thoroughly set, and it is convenient to the Department, a meter plate according to the size of the meter is laid on the sidewalk square with the curb, so that the meter register comes in the center of the plate. A hole in the sidewalk is then cut about a quarter of an inch larger than the plate, taking care not to crack the walk outside of the mark. The hole is excavated to about 3 inches below the bottom of the meter and the sides and ends of the hole extended about 2 inches under the walk. After the bottom of the hole is tamped, a wooden form is set covering the meter and the cut off. The plate is then set on the form and tamped down until the top of the same is level with the sidewalk. The plate is then removed and concrete is grouted all around the form to the surface. The plate is then put back and rests on the form while the concrete is setting. In time this wooden form rots away and leaves the plate resting on the concrete. A hole is left in the ends of boxes in case piping to the meter has to be renewed.

How Meters Are Tested

Meters are tested before they leave the factory, but to make sure they are correct the city again tests all meters before they are set. Our shop is equipped with modern testing benches for testing meters from 5-8-inch to 2-inch inclusive, and the water is discharged into tanks equipped with glass tubes on the outside. These glass tubes are equipped with buret floats on account of capillary attraction of water and are graduated in three stations, viz., beginning point, 5 cubic feet, and 10 cubic feet, which is stopping point. These buret floats have projections to keep them from adhering to the glass tube, and contain enough quick-silver to about half submerge them. The 5 and 10 feet stations are determined by weighing the water into the tank at 62½ pounds per cubic foot, so when a meter is tested the water is practically weighed through the tank readings.

These tanks were made tall and small in diameter to insure a big displacement for a small amount of water.

The register boxes of all meters are sealed after testing and no meter is taken from the meter shop for setting unless it is sealed.

We also have a large reinforced concrete tank which is also equipped with a glass tube and buret float and is used for the testing of larger meters, etc.

During the last fiscal year the Department tested an average of 3134 meters per month.

After meters are tested the water is pumped up to 100 lbs. per square inch to insure against leaking main casing gaskets and stuffing boxes.

When Customers Complain

A great many people really believe that water meters rob them by over-registering, and request that their meter be tested. We explain and try to talk them out of having it done, but sometimes the more we explain the more determined they are to have the test made. We then take their order and request that they or someone witness the test and tell them that if we find the meter over-registering, that there will be no charge for the test, and that we will rebate the back bills already paid. The charge for testing is as follows: ⅝ to 1-inch, $2.00; 1½ to 2-inch, $3.00; 3 and 4-inch, $6.00; 6 and 8-inch, $8.00.

The ⅝ and 1-inch meters are sometimes tested at the premises, by shutting off the water, taking the meter out and connecting it to the curb cock with a piece of hose. Then a meter of known registration on variable flows equipped with a valve on the outlet side is connected to the meter to be tested. Larger sizes are taken to the shop to be tested, leaving a new meter in its place, and if the meter being tested is low in registration or needs any repairing it is not put put back. In twenty years of experience I cannot recall over two cases where meters were found over-registering enough to warrant any rebate and those were very small.

We have yet to test a new meter that will describe an absolute straight line on variable flows. There is always a flow which shows a high peak of registration; because at this particular flow the meter is more positive in displacement than at any other; it does not show a loss through sensibility or a slippage by over-running. At high peak registration flows we aim to test and gear our meters and they usually leave the shop recording 98 to 101 per cent.

When a disk piston meter is new, one complete nutation or gyration of the disk means the passage of a quantity of water equal to the effective volume of the chamber. Any slight slippage due to the piston not perfectly fitting the chamber is taken care of by the change gears.

Vegetable Lubricant

After this meter has been in service for a few months and the draft has not been high and the water has been free from grit, etc., there appears a deposit of slick vegetable matter on the piston, and all over the inside of the measuring chamber. This deposit tends to lessen slippage and slightly reduce the quantity of water displaced by each nutation of the disk, hence the meter shows a slight increase of registration.

This kind of a deposit acts as a lubricant and tends to prolong the life of the meter. The increased registration through the meter is negligible and, as a rule, short lived, and the consumer has nothing to fear in this respect. On every meter that was taken out for not operating, due to being worn out, it is safe to say that the consumer got more water than he paid for.

The Department has some meters in service equipped with straight reading intermittent registers that require close watching. Most of these meters were acquired through the taking over of water companies by the city. This type of register can over-register at times, by one of the mutilated gears creeping back on its shaft and getting on the face of the counter wheel which drives it. This gear then becomes disengaged from the next higher counter-wheel which it should drive and leaves it free. The first counter-wheel is fastened on the shaft that the other wheels revolve upon and as this shaft revolves the disengaged counter-wheel at times creeps with it.

This intermittent straight reading register is gradually being replaced with the round dial constant moving type. This faulty construction, well known to us, is closely watched and before long will be a trouble of the past. If the consumer knew how careful the department is in regard to the testing of meters before they are set and what a remote chance there is for his meter to over-register, I think he would be perfectly satisfied.

Practically all meter repairing is done

(Continued on Page 92)

Welcome Awaits You at the Neptune Meter Exhibit at the San Diego Convention of A. W. W. A., California Section, October 28th, 29th and 30th.

A visit to our booth will prove both interesting and profitable. You will find on display our Trident Disc Split Case Meter, Trident Crest Meter, Trident Compound Meter, Trident Protectus Meter and Red Top Relief Valves.

The following members of our organization will be on hand to greet you: J. R. Barker, Pacific Coast Mgr., C. A. Braslan, T. J. Kells, L. E. Northrup, A. H. Nye, and D. S. McFarland.

NEPTUNE METER COMPANY

Pioneers in Meter Progress

50 EAST FORTY-SECOND STREET, NEW YORK CITY

Main Pacific Coast Office and Distributing Warehouse
701 E. Third Street, Los Angeles

San Francisco
320 Market

Seattle

Portland
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BEARINGS
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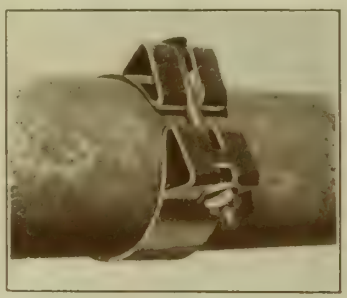


Philbrook Bolted Clamp
Saves Time
Stops Leaks

Equal pressure around pipe. Guaranteed satisfactory. May be ganged together (3-inch face) in any number. Use any suitable gasket material. Stock sizes 1½ to 24 inches. Larger clamps made to order.

Write for Price List

Philbrook Spring Pipe Clamp Co.
621 E. 12th St., Los Angeles, Cal.

WITH THE EXHIBITORS AT THE SAN DIEGO WATERWORKS CONVENTION

The exhibits of the manufacturers at the annual conventions of the California section of the American Water Works Association form one of the most impressive features of the meeting. Following is a list of those who will have exhibits at this year's convention at San Diego, Oct. 28 to 30, together with a brief description of their displays:

BYRON JACKSON PUMP COMPANY will have an interesting exhibit, showing a very modern built-in motor for deep-well pumping; a complete cut away section of deep well turbine pump; and a four-stage high duty bronze studded multiplex pump, with case opened up to show complete rotating element. L. A. Chenoweth will be in charge, and E. F. Lewis will also attend the convention.

CHAPMAN VALVE MANUFACTURING COMPANY will exhibit several different types of standard and low-pressure valves, which will be shown by Q. J. Magary, engineer of the Los Angeles office.

MUELLER MANUFACTURING COMPANY will feature in their exhibit copper service pipes and fittings. They will also have a full line of water pressure regulators and various water works fittings. W. L. Jett, manager of the Los Angeles plant, and T. F. Leary, manager of the San Francisco plant, will have charge.

WATER WORKS SUPPLY COMPANY, featuring especially the Leadite joint, will have on exhibit a Leadite joint that has been underground for 27 years. They will also show Simplex Air and Vacuum valves; Rensselaer gate valves, Corey fire hydrants; and Simplex Venturi meters. L. H. Chamberlain, manager of the Los Angeles office, will be in charge of the exhibit.

CALIFORNIA FILTER COMPANY, San Francisco, Los Angeles, and Seattle, will have on exhibition the various types of filters manufactured by them, as well as many photographs showing installations. Paul Bovard, assistant manager, will have charge of the exhibit.

FRANK J. KIMBALL PUMP COMPANY, Los Angeles, will feature in their exhibit samples and sectional parts of the Kimball direct flow turbine pump. J. K. Haigh, assistant sales manager, will have charge of the exhibit.

KENNEDY VALVE MANUFACTURING COMPANY. Kennedy valves and hydrants will be exhibited in detail, each sample showing the latest improvements. F. J. Henkenius, branch manager at San Francisco, and G. J. Reardon, the Los Angeles representative, will have charge.

McWANE CAST IRON PIPE COMPANY will feature their Pre-Calked Joint and will have pictures and models of cast iron pipe fittings and water works supplies. H. M. Dudley, Pacific Coast sales manager, with headquarters at Los Angeles, and A. Van Vechten, of San Francisco, will have charge of the exhibit.

MODERN IRRIGATION, published by Petroleum World Publishing Co., Los Angeles, will be represented at the convention by Owen Brown, president, W. C. Monroe, vice president, Russell R. Palmer, editor, and R. H. Thiess, special representative. Copies of the October issue, the special Waterworks Number, will be available.

NATIONAL METER COMPANY, New York, will show a full line of meters. One of their special exhibits will be a large displacement type meter, operating with water flowing through it, showing principle of operation of the meter mechanism. G. H. Bailey, Pacific Coast manager, Fred D. Webster, Sidney S. Small, Chas. P. Bergman, and M. J. Brooks will be in charge.

NEPTUNE METER COMPANY, manufacturers of the Trident Disc, Crest, Compound, and Protectus water meters, will have a complete line of meters on display. J. R. Barker, Pacific Coast manager, C. A. Braslan, T. J. Kells, A. H. Nye, and D. S. McFarland will be in attendance.

B. NICOLL & COMPANY, New York, will show samples of Pont-a-Mousson Cast Iron pipe and fittings. C. T. Claussen, Pacific Coast manager, and W. S. Conner, Los Angeles representative, will be in charge.

PACIFIC STATES CAST IRON PIPE COMPANY, will exhibit pictures and models of cast iron pipe, fittings, and water works supplies, which will be shown by H. M. Dudley and A. Van Vechten.

PHILBROOK SPRING PIPE CLAMP CO. will have on display the Philbrook bolted clamps and Stallard union. C. B. Meskimons and M. F. Prescott will have charge of the display.

UNITED STATES CAST IRON PIPE & FOUNDRY CO. will exhibit cement-lined pipe as well as deLavaud Centrifugal Cast Iron Pipe in a full line of sizes. They will also show various types of joints among which will be the Anthony joint which will be new to the trade. R. W. Martindale, Pacific Coast manager, A. R. Housmann, and Lee H. Chamberlain will have charge of the exhibit.

C. W. SIRCH, Los Angeles, will exhibit the Sirch filters and a line of swimming pool fittings, which will be shown by Chester D. Walz.

WALLACE & TIERNAN COMPANY will exhibit various types of Chlorine Control Apparatus for water purification, and Chemical Dry Feeder Apparatus. The operation of the equipment will be explained by Alexander Bell, Pacific Coast representative; Wm. J. O'Connell, Jr., engineer of the San Francisco office; G. T. Luippold, manager of the Los Angeles office, and A. L. Frick, Jr., engineer of the Los Angeles office.

WESTERN PIPE & STEEL COMPANY will have a large exhibit featuring Lock Bar, riveted, and welded steel pipe, Well casing, Tower tanks, Steel water tanks, and Storage tanks. They will also show different methods of protective pipe covering. A number of representatives of the company will be in charge, including L. N. Slater, W. B. Stanford, H. G. Tallerday, Roy Koster, H. A. Walter, W. G. Gates, and R. D. Plageman.

WAILES DOVE-HERMSITON CORPORATION, New York. S. J. Porter, Pacific Coast manager, will show samples of Bitumastic.

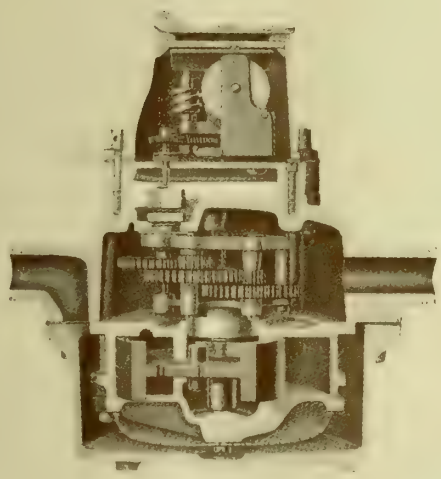
WORTHINGTON COMPANY, INC., will feature a complete line of cold water meters of Disc and Turbine type. The exhibit will be in charge of Arthur Crooke, of the Los Angeles office; F. T. Shoemaker, San Francisco, and Wm. Gustafson, Los Angeles.

R. W. SPARLING, Los Angeles, will have

For Detailed Listings See the Western Buyers' Guide of Waterworks Equipment—Pages 75-76

THE SUPREME METER

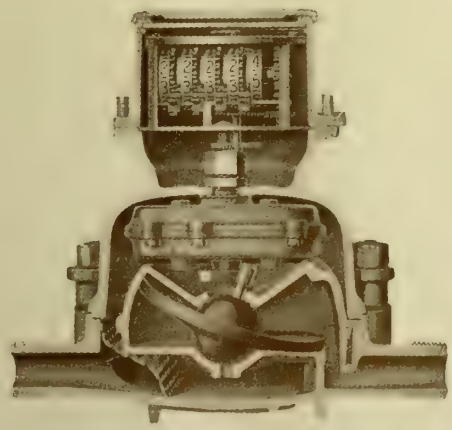
for water works service



EMPIRE METER

THE EMPIRE OSCILLATING PISTON type of meter is made in Sizes up to and including six inches. Their accuracy in even the largest sizes is often described as "astonishing." They are equally valuable for their lasting qualities and their low cost of upkeep.

We recommend the use of large EMPIRE METERS in place of batteries of small meters. First cost and maintenance lower—Accuracy greater.



NASH TYPE K METER

SIX TYPES IN ALL

With six distinct types, we are in a position to supply a meter for every exacting requirement. The Nash Disc Water Meter (shown at lower left) embodies every feature of merit to be found in any meter of this type. It is simple and substantial in construction. The excellence of this design has been proved by many years of successful service.

Pioneer Manufacturers of Water Meters Since 1870

NATIONAL METER COMPANY

MAKERS OF CROWN, EMPIRE, NASH, GEM, EMPIRE-COMPOUND AND PREMIER METERS.

LOS ANGELES
645 SANTA FE AVE.

SAN FRANCISCO
1048 FOLSOM STREET

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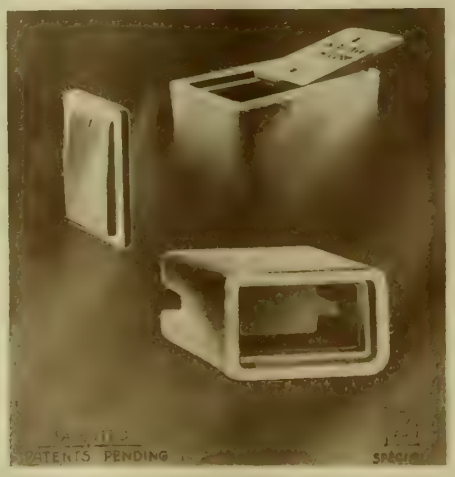
A size and type for every purpose.



In use by over 300 Water Works.

ART CONCRETE WATER METER BOXES

The only concrete box manufactured in cast iron molding machines. A semi-wet mix tamped with pneumatic rammers.

See our complete exhibit at the San Diego Convention—including our new No. 65 Box for big meters.

ART CONCRETE WORKS

Los Angeles PASADENA Oakland

Air chamber designed by E. E. Everett for G. Ferro & Co., Ventura, Calif.

WATER SURGE and WATER HAMMER

Successfully Controlled by

Air Chambers

Scientifically designed and figured for high pressure pipe lines.

A large number are in use in Ventura County, Calif.

E. E. EVERETT

Civil and Hydraulic Engineer
2150 Lincoln Drive
Ventura, Calif.

an interesting exhibit featuring recording gauges. One new to the trade is the Metrograph, to be used in connection with the meter to give a graphic record of the flow. They will show a Differential gauge, which records any loss of head through any orifice, and a Balance Flow regulating valve.

M. GREENBERG'S SONS, of San Francisco, will feature the following equipment: Greenberg standard single outlet hydrant; Greenberg steamer fire hydrants; Keystone type fire hydrants; Los Angeles new approved type iron body fire hydrants which can be repaired in the field; brass and iron fire valves and wharf hydrants; hydrant spanner wrenches and special hydrant connections, monitor nozzles, adapters, etc. The exhibit will be in charge of Stuart N. Greenberg, of San Francisco and Wm. S. Foster of the Los Angeles office.

GRINNELL COMPANY OF THE PACIFIC will have on exhibit the following: Grinnell detector check valve; cast iron pipe; underground socket fittings; hub-end gate valves; and Grinnell automatic sprinkler. J. S. Gibson, A. C. Hacker, and C. H. Chase will be in attendance.

HERSEY MFG. COMPANY, South Boston, Mass., will have on display their compounding valves and a full line of their meters as follows: Detector meter for fire service; compound meter; torrent meter and disc meters. The exhibit will be in charge of R. W. Keene and W. L. King, of the Los Angeles office, and Allen Jack of the San Francisco office.

HILL, HUBBELL & COMPANY, Technical Paint Specialists, will include in their exhibit specimen pieces of pipe and plates coated with their corrosion preventives—Biturine Pipe Dip, Biturine Enamel, Bitulumin (aluminum paint) and Number Two Fifty Iron Primer. The company believes this exhibit will have special educational value as these products have been widely used both in this country and abroad, in all sorts of climatic conditions. This company maintains offices in San Francisco, Los Angeles, Seattle, Portland, Baltimore, Tulsa, and New York City. The exhibition will be in charge of J. E. French and Francis Longley, from the San Francisco office, and Walter Ferem of the Los Angeles branch.

JAMES JONES COMPANY, Los Angeles, will have on display in their exhibit bronze corporation and service cocks, pipe clamps, gate valves, angle valves, and fire plug valves. W. W. Connor will be in charge of the exhibit.

AMERICAN BRASS COMPANY. The special feature of the exhibit will be Anaconda brass and copper pise for water services and Anaconda red brass flexible connections. A. W. Gruss, San Francisco agent, and G. T. Piersol will have charge of the exhibit.

COMMERCIAL IRON WORKS will show, in connection with Western Metal and Supply Co., a complete line of Butterfly valves, Flap valves, Check valves, and plugs and caps.

WESTERN WATERWORKS, Supplement of Modern Irrigation, published by Petroleum World Publishing Company, will be fully represented at the convention. Owen Brown, president, W. C. Monroe, vice president, and Robert H. Thiess, special representative, will represent the business organization, and Russell R. Palmer, editor, and Graydon Oliver, technical editor, will be on hand from the editorial department. Copies of the magazine will be available.

WESTERN METAL SUPPLY COMPANY, San Diego, will feature a full line of valves of Butterfly, Flap, and Check types, as well as plugs and caps.

(Continued on Page 72)

For Detailed Listings See the Western Buyers' Guide of Waterworks Equipment—Pages 75-76

Lamco Steel Products

for irrigation service

THERE are no boundaries to our service. The above photograph shows a shipment of six carloads of Lamco Pipe of various kinds sent to different purchasers in the Southwest.

With every facility for producing pipe and tanks to your specifications we are in a position to better serve you. Irrigators throughout the West depend upon Lamco Service.

Established 24 years ago.

Lamco Products:

Riveted Water Pipe and Fittings
Double Well Casing
Single Well Casing
Gravity Tanks
Pressure Tanks
Storage Tanks
Truck Tanks
Lamco Water Softeners
Surface Irrigation Pipe

Catalog Upon Request

Los Angeles Mfg. Company

2500 E. 23rd Street Los Angeles, Calif.

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WATER PURIFICATION

Contends Water Companies Cannot Make Own Chlorine to Advantage

Pacific Coast Authority Feels That Sacramento's Engineers Overlooked a Few Cost Items When They Figured It Was Cheaper to Make Own Chemical

By C. T. HENDERSON

IN THE July 29th issue of *Engineering News-Record* appears an article entitled "Home Electrolytic Chlorine at Sacramento," by Harry N. Jenks, Superintendent Pumping and Filtration Works, Sacramento, Calif.

If we take the figures stated in this article at their face value no municipality can possibly afford to buy liquid chlorine at 12½ cents per pound for water purification purposes but must, of necessity, produce its own chlorine on the premises.

Believing that the true facts were not altogether reflected in this article, or, in other words, feeling that Mr. Jenks' article represented one viewpoint rather than a bird's eye view of the situation, a complete investigation of the Sacramento installation was undertaken.

Question of Accounting

At the outset there was encountered the fact that municipal bookkeeping and bookkeeping as done by private enterprises are quite different, in that factors which are considered as expense items by those who must operate for stockholders' profits are entirely overlooked in municipal accounting.

The original Sacramento electrolytic installation consisted of Marsh cells which are said to have been totally unsatisfactory, and which were, consequently, scrapped. Of course, in private enterprise the capital invested in this original installation would have been charged up to experience, and interest on this capital would afterwards be carried forward as an item of cost in figuring unit prices of material produced until such time as the loss could be absorbed out of profits.

However, in municipal accounting the position is taken that the present operating staff cannot be held responsible for the mistakes of those who designed the plant; consequently the expense of installing and tearing out these Marsh cells is simply wiped off the slate and not taken into consideration in figuring present day costs of producing chlorine. While, of course, it is probable that such a mistake would not be made in subsequent installations, still, so far as the Sacramento installation is concerned, it cannot properly be said to be earning a profit for the municipality until such time as the cost of the discarded Marsh cell installation has been absorbed out of savings. These original Marsh cells were replaced with six diaphragm type cells designed and built by an employee of the filter plant, who had formerly been connected with the Hooker Electrochemical Co., and who was, consequently, familiar with the design and construction of chlorine cells. While no accurate data is available regarding the cost of these cells, it is probable their cost was not less than $300 each, making the investment in electrolytic cells now in use $1800.

CAN water companies and municipal water works manufacture their own chlorine cheaper than they can buy it? This is the question that has brought forth a spirited controversy in western water works circles since July last, following the publication of the article by Mr. Jenks (and mentioned herewith by Mr. Henderson) in the July 29th issue of Engineering News-Record. Mr. Jenks is slated to read a more lengthy report on this same subject at the San Diego convention and the topic bids fair to become one of the livest up for discussion on that occasion.

WESTERN WATERWORKS holds no brief for or against the proposition put forward by Mr. Jenks, believing that, in due course, it will be decided upon its own merits. At this time, however, in view of the prior publication of the article in question, and because of the great interest which it has aroused, we feel that readers of WESTERN WATERWORKS will welcome a full discussion of the matter by an authority who does not agree with Mr. Jenks' conclusions. Mr. Henderson, the author, is vice-president of the Great Western Electro-Chemical Company, and is well qualified to represent those who maintain that the Sacramento experiment is far from conclusive. Further data upon the subject of chlorine manufacture and costs will appear in a later issue.

—Editor.

Equipment Gets Good Care

The present cell equipment is operated under the most favorable conditions conceivable, in that it is being operated by its designer, who quite naturally bestows upon it the care and attention any man would bestow upon an equipment of his own design and construction. It is not probable that electrolytic cells in any ordinary installation would be as well looked after and maintained as are the electrolytic cells at Sacramento.

The motor generator equipment consists of 2300-ampere and 1600-ampere set, each set consisting of a Westinghouse 3-phase induction motor, direct connected to a 25 volt D. C. generator. While no accurate figures regarding the cost of these motor generator sets are available, it is probable that their total cost, delivered and erected, will not be less than $6,000.

The operating staff at Sacramento claims that 2½ KWH on the A. C. side of these motor generator sets will produce 1 pound of chlorine; the cost of electric power is 8½ mills per KWH. It is also stated that 4 pounds of salt at $7 per ton will produce 1 pound of chlorine. Further than this no specific statement is made regarding the details of the cost of production, nor any statement regarding the total cost of producing chlorine, other than the general statement contained in the article of July 29th that the total cost of producing varies from 5 to 7 cents per pound.

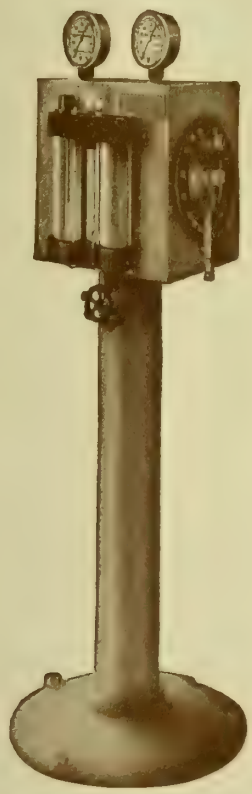
The annual production of chlorine at Sacramento amounts to approximately 15 tons.

Cost Items Omitted

Particular attention is called to the fact that no mention is made of the cost of diaphragms, which will amount to not less than $2 per ton of chlorine produced; nor is any mention made of the cost of anodes, which will probably amount to not less than $5 per ton of chlorine produced.

Again, nothing is said about the cost of labor, supervision or chemical control, apparently on the theory that labor, supervision and chemical control must be there for the operation of the filter plant, and no extra cost is involved in taking care of the electrolytic installation. The fallacy of this argument is so apparent as to call for no comment whatsoever. It is a mistake commonly made by those

Chlorination



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has become standard practice for the sterilization of water,—the sanitation of swimming pools,—the disinfection of sewage,—the elimination of noxious odors,—and for many other purposes,—largely because of the accuracy and reliability of W&T Chlorine Control Apparatus.

¶ Chlorination of drinking water is not only unsurpassed community health insurance but it is downright good business insurance,—in view of the recent tendency of the Courts* to award damages to persons stricken with intestinal disease caused by polluted water.

*See Engineering News Record, Vol. 97, No. 1, p. 30.

"The only safe water is a sterilized water"

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unfamiliar with cost accounting practices.

If we take the statement of the operating staff as being correct, then the true picture of operating cost is about as follows:

Direct cost per pound of chlorine produced:		
4 lbs. of salt @ $7	1.4	
2½ KWH @ 8½ mills	2.125c	
Diaphragm renewals at $2 per ton of chlorine	.1	
Anode renewals @ $5 per ton of chlorine	.25	
Total		3.875c
Indirect expense may be figured as follows:		
Maintenance cost on electrolytic installation at 33 1-3% per year	$600.00	
10% depreciation on electrical equipment	600.00	
Interest on capital invested at 5%	390.00	
Insurance at 1%	78.00	
Total		$1668.00
With an annual production of 15 tons chlorine, this amounts to $11.20 per ton or, per lb.		5.56c
Added to the direct charge of 3.875c per lb. as itemized above, total cost becomes, per lb.		9.436c

Apparent Saving Is $819.50

The annual cost of operating the plant with a production of 15 tons of chlorine will, therefore, be $2830. Fifteen tons of chlorine purchased at 12½ cents per pound would cost $3750.00 and on this basis the city of Sacramento would seem to be saving $819.50 per year by producing its chlorine on the premises, rather than by buying it, but as already pointed out, they really should be deducting from this $819.50 a proper charge for labor, supervision, chemical control, etc.

If the municipality is willing to make an investment of capital in order to secure chlorine at the minimum cost, it would seem that the logical thing for them to do would be to invest in 18 one-tone chlorine containers, which the chlorine manufacturer would be glad to furnish for $3600 ($200 each) and which containers the chlorine manufacturer would be glad to take off their hands at any time at the full purchase price. The annual charge against these 18 one-ton containers would, therefore, be 5 per cent interest plus 1 per cent insurance, or $216.

City Is Losing

With these 18 one-ton containers available for the storage of liquid chlorine, the chlorine manufacturer could, and would be glad to, supply chlorine in multi-unit tank cars at a price not to exceed 6 cents per pound f.o.b. Sacramento, instead of 12½ cents per pound, the price charged for chlorine in 150-pound cylinders, or the 15-ton annual requirements for the sum of $1800. The cost of taking the 15 full containers off of a multi-unit tank car and replacing them with 15 empty ones once a year would be almost negligible; the three extra one-ton containers would be sufficient to take care of the needs of the municipality while a new supply was en route.

Adding the purchase price of 15 tons of chlorine in one-ton containers ($1800) to interest and insurance charges of $216, we arrive at a total cost for purchasing chlorine of $2016 annually, as against an operating charge for the production of home made chlorine of $2830.50, which means that the City of Sacramento is sustaining an annual loss of $814.50 by manufacturing chlorine on the premises, rather than by purchasing in one-ton containers.

All the foregoing statements have been predicated on the assumption that the figures given by the operating staff at Sacramento are entirely correct. However, these figures are somewhat inconsistent, and therefore, open to considerable question.

If an electrolytic cell producing chlorine could operate at 100 per cent current efficiency, then 342 ampere hours would produce 1 pound of chlorine.

Over All Efficiency 63.2%

The cells installed at Sacramento are designed for 600 amps. and would, therefore, at 100 per cent current efficiency, produce 42.1 pounds of chlorine daily, or the 6 cells would produce 252.6 pounds of chlorine daily. It is stated in *Engineering News-Record* that the 6 electrolytic cells installed will produce 228 pounds of chlorine daily; consequently, it must be assumed that the cells operate at a current efficiency of 90.3 per cent.

Figuring back from this same current efficiency of 90.3 per cent, and daily production of 228 pounds of chlorine, and 2½ KWH per pound of chlorine produced, the over all efficiency of the motor generator set must be 63.2 per cent, which figure will be used in subsequent calculations herein.

At the time the Sacramento plant was inspected, water was being filtered at the rate of 32 million gallons per 24 hours, and was said to be dosed with chlorine at the rate of one-half part per million, or at the rate of 132.8 pounds of chlorine per 24 hours. At the same time the electrolytic cell installation was operating at 600 amps. 25 volts, and was, therefore, if we take the figures of the operating department as being correct, producing 228 pounds of chlorine daily.

"Unbelievably High Dosage"

Two hundred and twenty-eight pounds of chlorine daily will dose 32 million gallons of water at the rate of .856 parts per million and not at the rate of ½ part per million. A dosage of .856 parts per million is an almost unbelievably high dosage, and certainly not a dosage which one would expect to be applied to raw water to be filtered and again chlorinated after filtration, as is the practice at Sacramento.

If we assume that raw water is being dosed at the rate of ½ part per million, then the daily chlorine production was only 132.8 pounds instead of 228 pounds and the current efficiency of the cells was only 52.6 per cent. If we assume that the dosage at the time of inspection was actually ½ part per million and that the current efficiency was 52.5 per cent, the power required to produce 1 pound of chlorine was 4.29 KWH and not 2.5 KWH, a difference of 1.79 KWH which at 8½ mills amounts to 1.52 cents per pound of chlorine produced, and makes the total cost of producing home made chlorine 10.956 cents, without charge for labor, supervision, etc.

Accounting Criticized

In conclusion, the figures given by the operating department at Sacramento do not check—the statements regarding cost of production given by Mr. Jenks are unsupported and consequently must be taken as his opinion rather than as a fact—so the plant may properly be criticized for having no accurate accounting system. Furthermore, it seems a fact that Sacramento could buy 15 tons of chlorine per year more cheaply than it can be produced "home made," even taking the more optimistic of the non-checking statements given by the operating department at the filter plant as the basis of calculation.

Again, if liquid chlorine were purchased there would be no possibility of capital loss through obsolescence for the chlorine cylinders could be turned into cash at any time, whereas, due to advances in the art of treating water, the present electrolytic plant may have to be scrapped at any time and the loss taken by the City of Sacramento.

Beverly Hills Water Safe

Beverly Hills, California, citizens have complained so much of the water that the chamber of commerce has sent out a report to all consumers explaining the situation. This report states that the water is entirely free from harmful bacteria and safe for domestic use, and says that the objectionable odor and taste are due to the presence of hydrogen sulphide and its resultants, which though disagreeable are harmless.

The cure for the situation lies in the following:

1. Additional water supply.
2. Filtration—probably mechanical sand filters.
3. Additional reservoirs.

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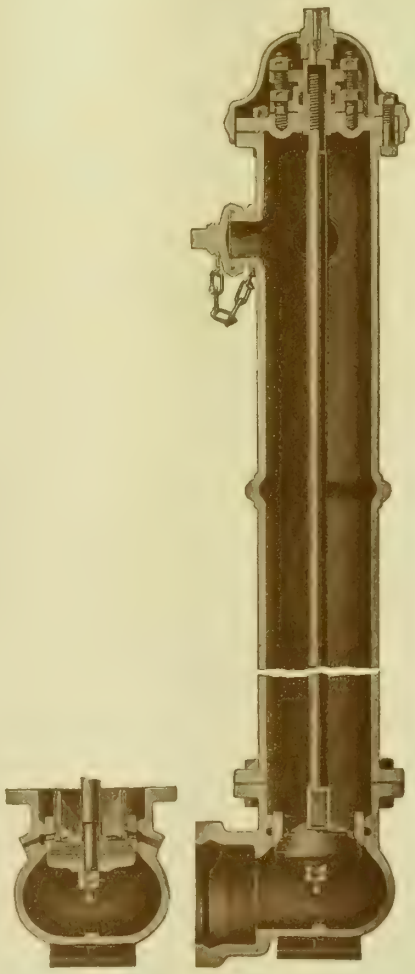

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Pacific Coast States Boast Lowest Typhoid Death Rate

New Water Supplies, as well as Filtration and Chlorination, Spell Doom of the Germ

THE Pacific and Rocky Mountain states, together with the East North Central States, have the lowest typhoid death rate of any of the geographic sections, according to figures compiled by the American Medical Association in 1925, with a score of 2.22 per 100,000 in cities of 100,000 or more. (Table 1).

TABLE 1

TYPHOID DEATH RATES IN THE VARIOUS GEOGRAPHIC DIVISIONS IN 1925

Cities of more than 100,000 population in	Population	Typhoid Deaths	Rate
New England states	2,308,266	56	2.42
Middle Atlantic states	11,279,063	333	2.95
South Atlantic states	1,354,748	110	8.12
East North Central states	7,344,968	163	2.22
East South Central states	570,012	92	16.14
West North Central states	2,072,228	64	3.09
West South Central states	717,491	103	14.36
Mountain and Pacific states	3,235,255	72	2.22

The Journal of the American Medical Association published in March, 1926, its fourteenth annual survey of typhoid fever mortality in the seventy-seven cities of the United States with more than 100,000 population in 1925. These cities have been grouped according to the recognized geographic divisions of the U. S. census bureau. In the Pacific-Rocky Mountain section ten cities (Table 2) are included; of these

TABLE 2

DEATH RATES OF CITIES IN MOUNTAIN AND PACIFIC STATES FROM TYPHOID PER HUNDRED THOUSAND POPULATION

	1925	1924	1921-1925	1916-1920	1911-1915	1906-1910
San Diego	0.9	....	....	....	....	.....
Oakland	1.2	1.3	2.0	3.8	8.7	21.5
Los Angeles	1.3*	4.4	3.0	3.6	10.7	19.0
Spokane	1.8	1.9	4.4	4.9	17.1	50.3
Tacoma	1.9	3.9	3.7	2.9	10.4	19.0
Portland, Ore.	2.1†	6.1	3.5	4.5	10.8	23.2
San Francisco	2.2	2.6	2.8	4.6	13.6	27.3
Seattle	2.5‡	3.2	2.6	2.9	5.7	25.2
Denver	5.0	5.1	5.1	5.8	12.0	37.5
Salt Lake City	6.9	10.1	6.0	9.3	13.2	.....

*Rate calculated on population figures furnished by the health department.
†December 1, 1924, to November 30, 1925.
‡Rate calculated on figures for population in 1924 with same annual increment added as 1922-1923 and 1923-1924.

San Diego is reported for the first time. Each of these ten showed less typhoid in 1925 than in 1924. The decrease was especially noticeable in Los Angeles and Portland. All the five-year averages, too, with one exception (Tacoma) show a reduction from each preceding five-year record. The five-year averages show a decided improvement all over the country, though for every section except the Pacific and Mountain states the record was higher for 1925 than it had been in 1924. It seems to be true that for most of the country 1925, like 1921 and 1913, was what might be termed a "typhoid year."

Cause for Good Record

To the introduction of new water supplies and the improvement of both new and old by means of sanitary protection, filtration and chlorination the heavy reduction and in many places the virtual disappearance of typhoid fever is largely due. No longer than 30 years ago typhoid death rates of 20 to 100 per 100,000 were common, with rates in bad years in the most afflicted cities running much higher. In 1925 there were two cities of more than 100,000 population (Lowell, Mass. and Scranton, Pa.) with no death from typhoid, and there were twenty-eight other cities with a rate of less than 2 per 100,000. Of these, five were in the Pacific-Mountain section.

Public water supplies not only substitute safe for unsafe drinking water, but also make possible sanitary sewers and with them the abolition of the dangerous privy and cesspool. With the privy the typhoid fly also disappears. The great reduction in typhoid fever in the United States registration area has been largely due to the measures taken in the urban areas. Reduction in rural typhoid has been less satisfactory.

Where Germs Breed

Typhoid fever organisms, so far as known, breed only in the bodies of infected persons, whence they are discharged. Unless these discharged organisms get back into the human body the line is broken. Water is one of the carriers from the infected person back to the second individual. Milk, other food-stuffs, and direct contact are the other media of infection, but they are not the concern of the water works official except as they confuse the question as to cause and its elimination. The term "infected persons" comprises all persons ill with typhoid fever, a considerable portion of recent convalescents, and about 3 per cent of all persons who have previously had typhoid fever.

All water, whether taken from surface or underground sources, has at some time since its precipitation been in contact with the surface of the earth, and has consequently been more or less exposed to pollution with the intestinal discharges of persons and lower animals upon its catchment area. Between the sources of pollution and the ultimate destination of the water are numerous agencies operating to reduce the numbers of typhoid bacilli and other intestinal bacteria which may reach the consumer. These safeguards comprise all the agencies which tend to destroy typhoid bacilli and other intestinal bacteria in the natural and artificial processes of sewage disposal and water purification.

Control of Water Supplies

A sharply defined epidemic of typhoid fever affords the best opportunity to determine definitely the effect of a water supply in the causation of this infection. This is so primarily because the very distinctness and sudden development of an epidemic argue the operation of a single, distinct and unusual cause, the spread of the infection from a single source, since it is essentially improbable that two or more unusual sources of infection should have developed independently and simultaneously.

Control and supervision of water supplies by health departments have been a gradual development of the past thirty years. In earlier times cities found little difficulty in securing supplies from sparsely populated water sheds or from sources which were not grossly polluted. With the rapid growth in population and an accumulation of knowledge of water borne diseases, the ever-growing menace to many municipal supplies began to be realized. Two protective courses were possible: better protection of the catchment areas, or nullification of the pollution by appropriate treatment of the water before delivery to the consumer.

The causative relation of polluted water to the toll in deaths was clearly established by the work of experiment stations. The reduction in typhoid deaths effected by substituting a filtered for a polluted surface supply was demonstrated in many American cities in the first decade of the twentieth century. Yet many cities refused to accept the lesson, and in such cases the state had to provide laws. The interest and activity of the Federal Government has been a large factor in encouraging state control of water supplies. The United States Public Health Service found that the most effective way to prevent the spread of water borne diseases was to assist in developing and perfecting state and local machinery for this purpose. By detailing or lending sanitary engineers to states, the Service has been instrumental in securing the establishment of a sanitary engineering division in more than a dozen states. Health departments of 43 states now have divisions of sanitary engineering, though many of these are as yet only "one man" divisions.

50 Years of Progress

Until 1870 there were no water filtration plants in the United States as the term is now understood, but some of

the surface supplies then in use were passed through so-called filters or strainers of gravel, charcoal or sponge. In 1925, according to figures of the American Water Works Association, there were about 587 rapid and about 47 slow sand filters in use, with a total capacity of approximately 5,000,000,000 gallons per day.

Chlorination dates from 1908. It is now used on nearly all surface supplies, whether filtered or not. In 1924* over 3,750,000,000 gallons per day were being treated in more than 3000 cities and towns of the United States. It is estimated that 70 per cent of the population of North America are drinking water treated with liquid chlorine. In all there are now 6000 installations of chlorinating equipment operating in the United States.

*Water Works Practice, chapter on Chlorination.

Plans $5,000,000 System

Santiago, Cuba, is planning the installation of a new waterworks system which, when complete, will cost approximately $5,000,000, according to a statement made by Dr. Elwood Mead, commissioner of reclamation. Dr. Mead has just returned from Cuba, where he went to advise the Cuban government with regard to this installation.

According to Dr. Mead, Santiago now has a population of 80,000 and, with the very rapid agricultural development of Cuba, it is destined to become a large city. It has a fine harbor and is the terminus of the railroad from Havana. The present water supply, however, is wholly inadequate. The Cuban government is going ahead with the proposed waterworks for Santiago, Dr. Mead stated, and specifications for the project are now being prepared.

Water Company Extends Lines

Increased demand upon the Hoquiam (Washington) water supply has made better facilities necessary, and to meet this demand the Hoquiam Water Company announces that work is well under way in the replacement of 2000 feet of 10-inch cast iron pipe by 16-inch pipe. Extension of the city mains across the Hoquiam river into the Woodlawn addition is nearly completed.

San Bernardino Builds Dam

A huge flood control and water conservation reservoir is being built by the San Bernardino, California, board of water commissioners on city-owned land. The dam will be 700 feet long and will have a capacity of approximately 12,000,000 gallons of water.

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SEWAGE DISPOSAL

El Segundo, Calif., Uses Asphalt for Sewer Joints with Success

By ADOLF H. KOEBIG, Jr.

FOR many years it has been quite a problem in the construction of sewers to find a joint that would do away with the infiltration of tree roots through the pores of the cement joints. Sanitary engineers throughout the country have been experimenting to overcome this feature by making the joints of cement more dense but invariably it rested with the mechanical workmanship of the contractor whether or not the joints could be made dense enough to overcome this difficulty.

For a long time the firm of Koebig & Koebig, as well as other engineers, have tried to introduce the use of an asphalt joint to overcome this problem. Mr. Ferguson, the inventor of hollow tile block for lining purposes in the construction of sewers, has advocated the asphalt joint to be applied in its cold state.

At the left a workman is shown "pouring a joint." Hot asphalt is the sealing medium being used, selected by the engineers for the reasons set forth in the accompanying article. On the right: line-construction work in a sandhill section.

Tried at El Segundo

In the designing and construction of the El Segundo, California, sanitary sewer trunk line system, serving the city, it was possible to introduce the asphalt joint, applied in a hot state, as the City of El Segundo is the location of a large refinery of the Standard Oil Company and the suggestion was looked upon favorably. The poured asphalt joint was adopted for the entire work, being the first sewer known in this territory, or perhaps throughout the entire western territory, that really has applied the use of the asphalt joint for sewer construction.

The first contract for installation was for approximately twenty-four thousand lineal feet of vitrified clay pipe, varying in diameter from eight inches to eighteen inches; the construction of a main pumping station and two ejector stations, and the driving of three tunnels, the total length of which is twenty-five hundred feet.

It was found in experimental work that the asphalt joint adhered equally as well on either cement or vitrified glazed pipe.

Topography a Problem

The peculiar topography of El Segundo necessitated the construction of two ejector pumping stations at the southerly end of the system. These plants will serve areas too low to be reached with a gravity line, and discharge into the main trunk line at the up-stream end, from where a gravity flow is provided to the main pump station located in the northwest part of the city. In this station are installed two four-inch centrifugal pumps, operating under a head of twenty feet, and discharging into the Los Angeles Belleview outfall sewer.

Adequate stand-by service has been provided to insure continuous operation of all mechanical equipment. The pumps are electrically operated, and, in an emergency, may be supplied with energy furnished by a gas-engine-driven generator, located in the same plant.

To facilitate the construction of the lateral system, the city was divided into districts. The contract was awarded for the installation of approximately twenty thousand lineal feet of six-inch and eight-inch vitrified clay pipe with asphalt joints and plans prepared for a lateral system to serve the remainder of the residence portion of the city.

At this time we have no definite detail cost data on the use of the asphalt joint, but I may say that the cost of the entire joint, labor and material, will only exceed the cost of the cement joint about 33 1-3 per cent, which is very small when you consider the results obtained.

Some of the advantages in the use of the asphalt joints are as follows:

1. The density and nature of the

Here are the advantages in the use of asphalt for sewer joints, as Mr. Koebig sees it:

1. The density and nature of the asphalt joint prevents the growth of roots in the sewer.

2. Any settlement occurring in the alignment of the sewer is taken up by the elasticity of the asphalt joint.

3. Industrial wastes and acids do not affect asphalt joints.

4. A defective join is always easily detected.

5. The greatest adhesion is obtained by pouring the joint while the asphalt is in a heated liquid state.

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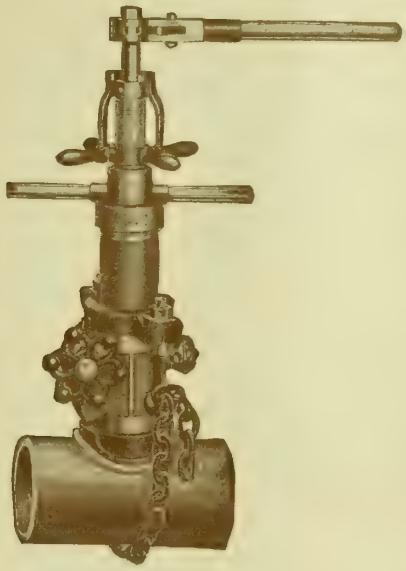

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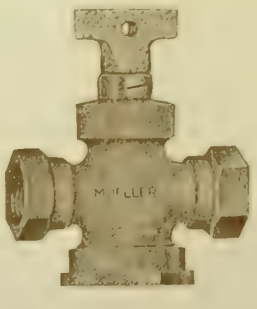

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asphalt joint prevents the growth of roots in the sewer, which is one of the greatest nuisances in the maintenance of the sanitary sewer system.

2. Any settlement occurring in the alignment of the sewer is taken up by the elasticity of the asphalt joint.

3. Industrial wastes and acids do not affect the asphalt joints.

4. In the use of the asphalt joint a defective joint is always easily detected as the asphalt, being in a fluid state, will run into the crevices of the defect.

5. The greatest adhesion is obtained by pouring the joint while the asphalt is in a heated liquid state.

Gaining in Favor

There is no doubt in the mind of the writer that asphalt joints will be used more and more each year in preference to cement joints, especially in the East where there is another advantage to be gained in the handling of the asphalt during freezing weather.

The engineers dealing with sanitary sewers are adopting the use of asphalt joints more and more each day. On account of the elasticity of a good grade of asphalt, and the fact that it is not brittle, it is looked upon very favorably in earthquake territories, especially in sections of California where earthquakes have occurred.

The sewer system of El Segundo was designed by the city engineer, R. T. Hutchins of El Segundo, and Koebig & Koebig, consulting engineers, 821 Title Insurance Building, Los Angeles.

Discuss Sewage Problems

The American Society of Civil Engineers turned its regular quarterly fall meeting into an annual convention at Philadelphia, which lasted six days, from October 4 to 9 inclusive. The sanitary engineering division at its Wednesday meeting presented 150-year reviews of the progress in seven fields of sanitary engineering. George W. Fuller read a paper on waterworks; Harrison P. Eddy discussed sewerage; Dr. George T. Palmer dealt with ventilation; and S. H. McCrory talked of land drainage.

The Thursday morning session was given over to a symposium on industrial waste disposal, devoted chiefly to current phases of the subject as regards four classes of waste. The four specific wastes discussed in papers were as follows: oil refinery, Robert Spurr Weston; coal mine drainage, Andrew B. Crichton; pulp and paper mill wastes, George K. Spence; tannery wastes, Wilhelm Howalt. The symposium stressed the growing co-operation between state authorities and the various waste-producing agencies in the control of pollution.

Lake Michigan Sanitation Congress in Annual Meeting

The Lake Michigan Sanitation Congress held its third annual meeting at Racine, Wisconsin, on September 24 and 25 with about 100 present. The purpose of the congress is an exchange of information between officials and those working on the water and sewage problems of the lake cities in Michigan, Illinois, Indiana and Wisconsin. There was a three-session program, with 25 speakers, and on the second afternoon the delegates inspected the Milwaukee sewage works.

"The Relation of Industrial Waste to Sewage Treatment" was the subject of a paper read by C. M. Baker, state sanitary engineer, in which he discussed specifically the co-operative work between paper mills and canning factories and the state board of health in working out solutions of the waste problems. Recovery of $28,000 worth of wood fiber annually at a 50-ton sulphite mill costs $15,000 for installation and removes the equivalent of the sewage of 150,000 people.

H. P. Ramey, assistant chief engineer, Sanitary District of Chicago, outlined the progress made by the district in meeting the requirements of the War Department in accordance with the provision of a grant of 8,500 second feet of diversion water from Lake Michigan. More than $45,000,000 has been spent on sewage disposal and the program demands about $12,000,000 annually. The North Side activated-sludge plant, the largest plant of its kind in the world, planned to care for 800,000 people, is three-fourths complete, and cost $21,000,000. The West Side plant, for 1,600,000 people, has been started. At least one-third of the plant must be completed by 1928.

Milwaukee's Plant

T. C. Hatton, chief engineer, Milwaukee Sewage Commission, reported that the activated-sludge plant of that city is treating 45 m.g.d. The sludge is filtered, dried and sold at an average net return of $13.48 per ton. Seventy per cent is sold to fertilizer companies, 20 per cent to golf courses, and 10 per cent for city lawns. Mr. Hatton states that there is a ready market for all that Indianapolis and Chicago can produce.

Other points brought out at the sessions were as follows: That analyses show that a safe lake water cannot be obtained nearer than from seven to eleven miles out; that filtration is coming for Chicago, $100,000 having been appropriated for experiments; that Racine has a filter ready for operation within two months' time; that filters alone without elimination from the lake of sewage from the cities of Northern Indiana will not produce a satisfactory water free from phenol tastes; and that the analyses of more than 30,000 samples of water taken in three years show that Waukegan distributes the least safe water of any city from Waukegan to Gary, because of insufficient chlorine.

Officers of the congress were re-elected as follows: H. W. Lee, president; J. A. Hendricks, secretary.

Cement Concrete Pipe Tests Are Made at Selma, Calif.

Is One of a Series Being Conducted by Association; Report Will Be Issued When All Are Completed.

The California Associated Concrete Pipe Manufacturers held their fall convention at Fresno on October 9. The program was especially prepared for engineers and others who wished to know more about concrete pipe manufacture, the association presenting a series of exhibits and public tests on irrigation, sewer and culvert pipes, to demonstrate the range of uses to which these products are adaptable.

Hydrostatic tests were run on single sections and laid lines of concrete pipe to show their resistance to internal pressures when used as conduits for carrying water under pressure heads. The imperviousness and tensile strength of non-reinforced and reinforced concrete pipe as manufactured by various methods was brought out by the hydrostatic tests.

Crushing tests were run on single sections of both plain and reinforced pipe to show their resistance to external loads. The materials, gradings, proportions, and methods of manufacture were exhibited for each specimen tested.

The tests were held in the yards of the I. Jourdan Company at Selma, California, twelve miles South of Fresno, where a modern manufacturing plant is in operation enabling the visitors to view the manufacturing process for "machine made" concrete pipe in all its details.

Manufacturers of irrigation appliances exhibited their equipment and explained to engineers their uses in irrigation design.

The following is a condensed outline of the tests that were made:

1. *Irrigation Pipe*: Hydrostatic tests on ten laid lines of 10 and 12-inch concrete pipe showing types of reinforcing two types of joints and ten tests on individual sections of irrigation pipe.

2. *Sewer Pipe*: Hydrostatic tests on eight laid lines of concrete sewer pipe as used in sanitary sewers at Fresno and other cities. Crushing tests were run on individual joints of this pipe.

3. *Culvert Pipe: Crushing tests* on four types of plain and reinforced concrete culvert pipe of 12 to 36 inches in diameter.

The association announced that a comprehensive report on the tests would be made after several other tests, planned for different localities in the state, were completed.

Jackson Is Vice President of Merged Water Companies

Deal by Which Fresno, Bakersfield, Visalia and Chico Properties Pass to New Hands

Contsummating negotiations extending over a period of several weeks, the Federal Water Service Company of New York on Oct. 18 took over control of the Fresno City Water Corporation, Fresno, Calif., a $2,500,000 distributing system. The consideration was not given.

The old directorate of the company, headed by A. G. Wishon, president, resigned in a body and an entirely new board headed by E. T. Chenery of New York, president of the purchasing company, was elected.

C. B. Jackson, for many years general manager of the Fresno company, was elected vice-president and general manager and will be general manager of recently acquired properties at Bakersfield, ViVsalia and Chico, it was announced. E. B. Walthall, former assistant general manager of the San Joaquin Light and Power Corporation here, was elected vice-president and assistant secretary and assistant treasurer.

Other officers and directors are A. W. Cuddeback, New York, vice-president; Walter A. Culin, New York, secretary-treasurer; E. Pillsbury and J. G. Eliot, both of San Francisco, directors.

Until its sale control of the company was held by Western Power Company of New York, which acquired control in December, 1924, at the time Western Power took over San Joaquin Power.

New Fire Hydrant Head

The James Jones Company, manufacturers of brass goods such as used by municipal and public service corporations, have recently added to their line a fire hydrant head with double outlet cast in bronze. The valve seats and stuffing boxes are cast in as part of the hydrant. The Jones head can be used with either cast iron or standard pipe as a raiser. It is very simple in construction and can be taken apart for repair and put together again with an ordinary wrench, thus obviating the necessity for special tools.

You *Name the* Load
We *Make the* Pipe!

SINCE concrete pipe (as made by Bent) came into its own, engineers question no longer its striking advantages for a great variety of uses. *But*—a concrete pipe installation is either a mediocre or an eminently superior job of work, depending upon who fulfilled the contract.

Many trade names have become hall-marks of tradition, that serve as an unerring guide to discriminating buyers. Today the name "BENT" on a joint of Concrete Pipe marks it as a strictly finely made product. The same care and skill is exercised in its manufacture, and in the laying of the line, as though every future contract depended on *that* job meeting the fullest requirements of specifications—*and more.*

Let us give you a "concrete" demonstration of what we mean by "Bent" Service.

BENT CONCRETE PIPE CO.
GENERAL OFFICES: GROSSE BLDG.
Los Angeles -:- California

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FOR YOUR CONVENIENCE IN ORDERING

Publishers of MODERN IRRIGATION, Date.....192.....
626 So. Spring St., Los Angeles, Cal.

Gentlemen: Please send me "Modern Irrigation" every month for (one—three) years, for which I will send you ($2.00—$4.00) on receipt of your magazine. I reserve the right to cancel my subscription at any time and secure the return of my money pro-rata for the unexpired period.

Name ..... Title.....

Company .....

Address .....

Underscore your interest in irrigation or hydraulics: Irrigator (rancher, grower); Mutual Water Co.; Irrigation District; Land Co.; Public Utility Co.; engineer (civil, hydraulic, consulting); city engineer; water works manager; contractor; dealer or jobber; manufacturer. 7

For Detailed Listings See the Western Buyers' Guide of Waterworks Equipment—Pages 75-76

Bronze Fire Hydrant Heads

Service Cocks

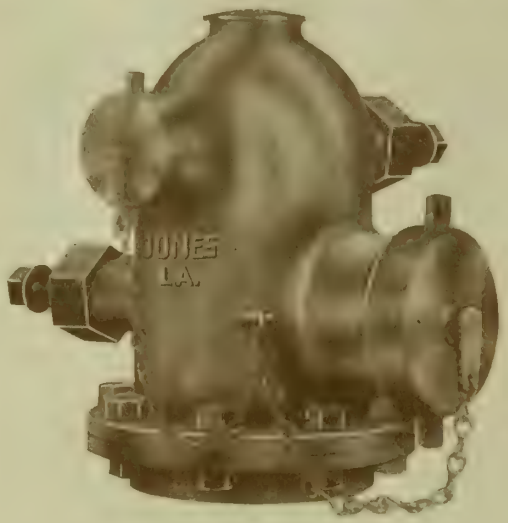
Angle Valves

Corporation Cocks

Gate Valves

Service Clamps

Lead Goosenecks



Manufactured and Distributed by

JAMES JONES COMPANY

Brass Works

201 Le Roy Street, Los Angeles, Calif.

YEOMANS

Centrifugal Sewage Pumps

HEAVY duty slow speed direct connected Centrifugal Pumps for handling crude sewage or settling tank effluent and sludge in municipal sewerage systems. A wide yoke thrust bearing permits raising top plate of pump without disturbing working parts. Liberal water passages insure against clogging.

Also built in horizontal design.

Complete installations for municipalities designed, built and erected.

Yeomans Brothers Company
CHICAGO

California Representatives

F. C. Millard Engineering Co.,
Rives-Strong Bldg.,
Los Angeles

C. H. Cobb,
Sharon Bldg.,
San Francisco

With the Exhibitors

(*Continued from Page 60*)

AMERICAN CAST IRON PIPE COMPANY will feature their new type Mono Cast Centrifugal Pipe J. J. Swenson, Pacific Coast manager and W. R. Blair, of the San Francisco office, will have charge of the exhibit and will explain the process of manufacture and special advantages of this type of pipe.

ART CONCRETE WORKS, Pasadena, California. Concrete water meter boxes in eight sizes, and service or valve boxes. Frank M. Brooks, of the Pasadena office, and H. L. Brooks, of the Oakland office, will have charge of the exhibit.

DEARBORN CHEMICAL COMPANY, Los Angeles, will feature their No-Ox-Id Rust Preventive. A. G. Burns and H. G. Smock, of the Los Angeles office will be in attendance.

DE LAVAL STEAM TURBINE COMPANY, Trenton, New Jersey, will have an exhibit of centrifugal pumps, worm gears, steam turbines, and flexible couplings. L. A. Safford, district manager, will be at the head of the exhibit, and he will be ably assisted by C. H. Johnston, from the Los Angeles office, E. L. McKie, of the San Diego office, and C. P. Markley, of the San Francisco branch.

EVERLASTING PAINT AND SALES COMPANY will have a full line of their products on exhibition, including Luminite, Concrete damp proofing, protective coatings for metals and woods, Hunt patent process for curing concrete, etc. Logan Thomas, of the Los Angeles office, will be in charge of the exhibit.

FORNI MANUFACTURING CO., Oakland, California, will show samples of the Forni concrete meter box. George & N. Forni will be in charge.

FAIRBANKS, MORSE & COMPANY will feature in their exhibit their Horizontal ball-bearing centrifugal pump, direct connected with the Fairbanks-Morse ballbearing motor. They will also show a bronze impeller for the Woods sewage pump.

OTHER EXHIBITORS will be Chicago Bridge & Iron Co., Steel Tank & Pipe Co., Pittsburgh-Des Moines Steel Co., A. N. Byers Co., General Electric Co., National Iron Works, Machinery Pipe & Supply Company, Baker Iron Works, Cement Gun Construction Co., Crane Co.

Purchases Three Water Systems

San Gabriel Valley Water Company has been authorized by the California Railroad Commission to purchase from the Huntington Land and Improvement Company, for the sum of $300,000, the water systems known as the Oak Knoll, Patton and Rosemead System, and to issue its promissory note in that amount payable on or before five years from date with interest at six per cent per annum, payable quarterly. The same utility, having applied to the Railroad Commission for permission to increase its rates, and the Commission after investigation having determined that the present rates are inadequate, has authorized that company to place in effect a new schedule of rates September 30, 1926, as follows: Domestic use, monthly minimum charges: for ⅝-inch meter, $1.25; ¾-inch, $1.75; 1-inch, $2.50; 1½-inch, $4.50; 2-inch, $6.00; 3-inch, $12.00; 4-inch, $20.00; 6-inch, $35.00. Monthly quantity charges: 500 cubic feet or less, per 100 cu. ft., $0.25; 500 to 5000 cu. ft., $0.20; over 5000 cu. ft., $0.12. Irrigation Use—monthly minimum charges: Same as for domestic use; monthly quantity charge, $0.08 per 100 cubic feet.

For Detailed Listings See the Western Buyers' Guide of Waterworks Equipment—Pages 75-76

This City Claims Water Record

Every man, woman, and child in Sacramento, California, theoretically at least, used an average of 312 gallons of water daily during the months of June, July and August, according to figures recently compiled by City Engineer Allan J. Wagner. The city filtration plant serves approximately 85 per cent of Sacramento's population, the remaining 15 per cent receiving water from the Oak Park and other private plants.

The records show a total of 2,545,900,000 gallons pumped by the filtration plant into the city mains, divided as follows: June, 852,200,000; July, 870,100,000; August, 823,600,000. Based on a cost of 7 cents per 1000 gallons delivered to the consumer, the per capita cost for the summer months was 2.2 cents daily. Wagner's conclusions are that Sacramento uses more water and gets it more cheaply than any city in the country.

Buys New Water Tract

Anticipating domestic water supply requirements for years to come, the commissioners of Santa Monica, California, have purchased fifteen water-bearing lots. According to Public Works Commissioner John A. Morton, more than double Santa Monica's present domestic water supply can be developed in wells on this property, known to hold underlying water-bearing sands of heavy underground reservoir capacity.

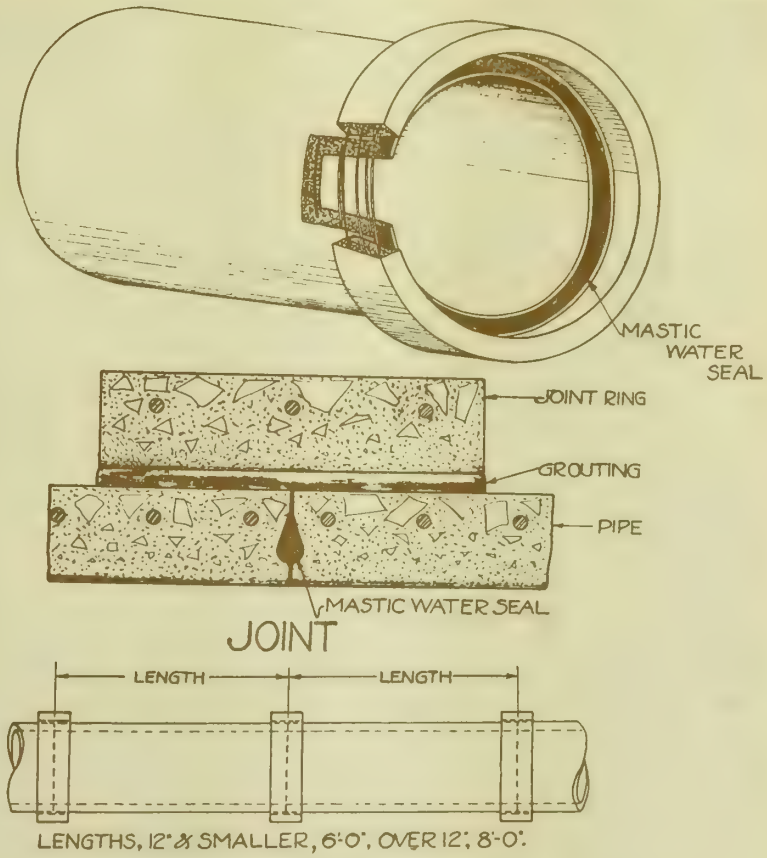
More than 500 inches of water is the yield of three municipal wells on the five adjoining lots owned by the city, and Commissioner Morton says five more wells should be sunk on the newly acquired land to tap water-bearing strata of tremendous yield. Three of these wells will be sunk this winter, the commissioner stated.

Redlands Will Double System

Redlands, California, expects soon to have one of the finest million-dollar domestic water systems in the state, from which about 1000 inches continuous flow can be provided. Work of doubling the water system with the funds from the $500,000 bond issue recently voted is now under way, with George Hinckley, city engineer, in charge. Redlands purchased from Old Town ranchers the 400 inches flow from Mill Creek which they owned, for about $400,000, it is stated. The gravity water from Mill Creek can be run on a level to the higher sections of the city. The city is to build a great pipe line to the hill sections to carry this water, and work on a $30,000 filter plant is now under way.

Centrifugal Reinforced Concrete Pipe

Spun by the Hume Process



Introduced Now in the West for High Pressure Pipe

This pipe is impervious to soil corrosion and free from leakage at high pressures. Tests show unit tensile strength in excess of 400 pounds per square inch, which is double that of the best concrete by old methods.

We are prepared to furnish and lay Hume Concrete Pressure Lines. Prices upon application.

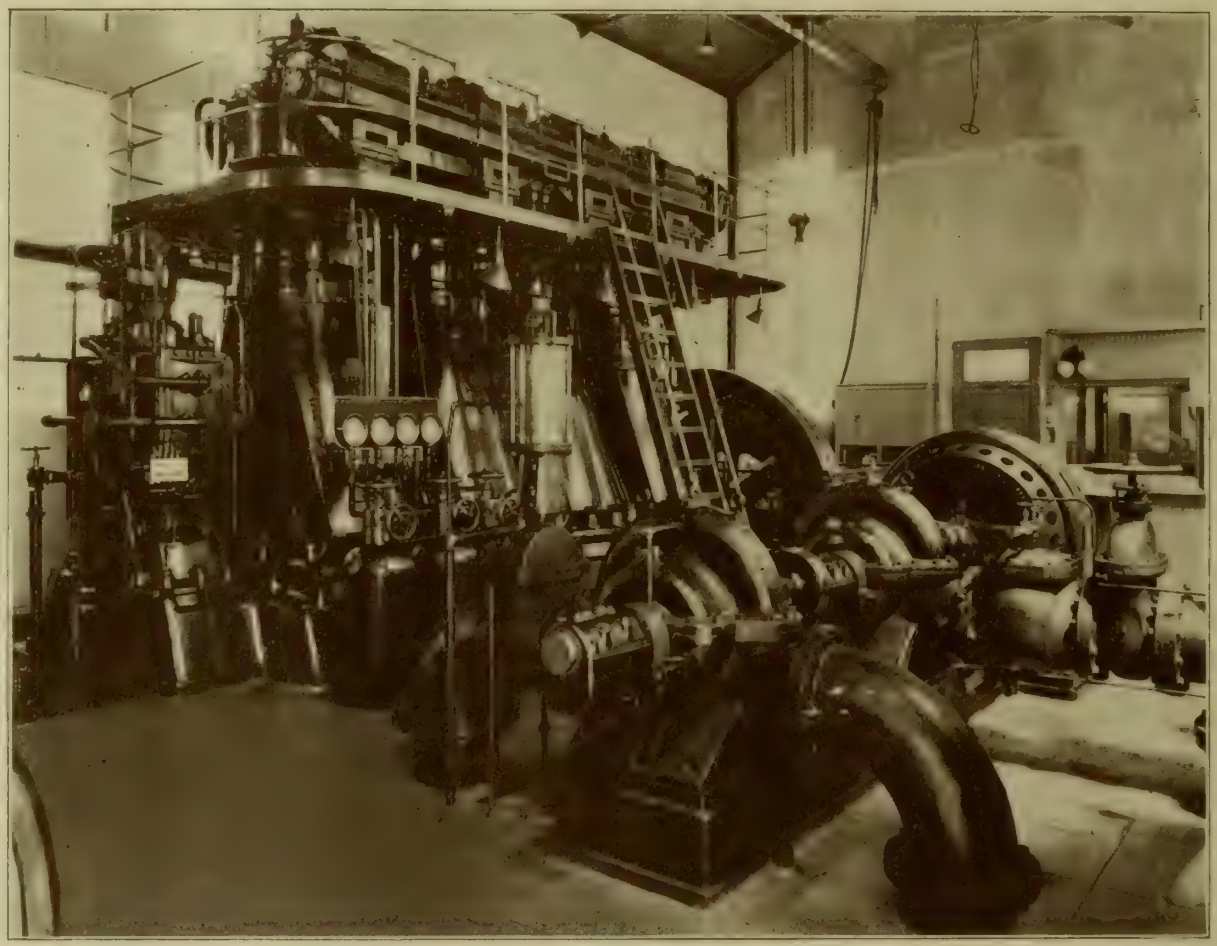
WESTERN CONCRETE PIPE COMPANY

P. O. Box 355, Los Angeles, California

For Detailed Listings See the Western Buyers' Guide of Waterworks Equipment—Pages 75-76

De Laval

Centrifugal Pumps



ONE OF SEVERAL DE LAVAL PUMPING UNITS IN USE BY THE CITY OF LOS ANGELES

DE LAVAL is the symbol of first quality only—backed by a company recognized throughout the world since 1901 as the largest builder of high grade centrifugal pumps for municipal and corporate water works.

Stocks of equipment and repair parts are carried at Los Angeles, San Francisco and Seattle, insuring immediate service.

DE LAVAL STEAM TURBINE CO.

LOS ANGELES
312 Union Oil Bldg.

SEATTLE
1306 L. C. Smith Bldg.

SAN FRANCISCO
531 Rialto Bldg.

For Detailed Listings See the Western Buyers' Guide of Waterworks Equipment—Pages 75-76

WESTERN BUYERS' GUIDE

OF WATERWORKS AND SEWAGE DISPOSAL EQUIPMENT

WESTERN WATERWORKS presents the following Buyers' Guide to the leading Western sources for waterworks equipment and auxiliary supplies. Purchasing departments, engineers and all others who do ordering or specifying will find this department of great practical value, listing as it does the most representative lines handled by western manufacturers and distributors. The listings herewith are not, as yet, entirely complete but will become more so with future issues of the publication. To this end, the publishers bespeak the active co-operation of the companies whose products are included below. Send all corrections or additional listings by mail and at the earliest possible before press date.

AIR LIFTS
Kimball Co., Frank J.
Woodin & Little

AIR CHAMBER DESIGN
E. E. Everett

ANTICORROSIVES
Hill, Hubbell & Co.
Everlasting Paint & Sales Co.
Dearborn Chemical Co.

ASPHALT, EMULSIFIED
Crown Bitumens Corp.

BEARINGS, BALL
Masterson, Jos. A & Co.

BEARINGS, ROLLER
Masterson, Jos. A & Co.

BOILER FEED WATER TREATMENT
Dearborn Chemical Co.

BOXES, METER
Art Concrete Works

BOXES, SERVICE, ROADWAY AND VALVE
Art Concrete Works
Michigan Valve & Foundry Co.

BRASS GOODS
James Jones Company

CASING, WATER WELL
American Steel Pipe & Tank Co.
Los Angeles Mfg. Co.
Montague Pipe & Steel Co.
Western Pipe & Steel Co.

CATCH BASIN COVERS
Art Concrete Works

CHEMICAL FEEDING APPARATUS, DRY
Wallace & Tiernan Co.

CHLORINATING EQUIPMENT
Wallace & Tiernan Co.
International Filter Co.

COATINGS, PROTECTIVE
Everlasting Paint & Sales Co.
Hill, Hubbell & Co.
Dearborn Chemical Co.

CONCRETE PRESERVATIVE
Crwn Bitumens Corp.
Everlasting Paint & Sales Co.
Hill, Hubbell & Co.

CONSULTING ENGINEERS
Smith-Emery Co.

CONCRETE PIPE MACHINES
Concrete Machinery & Supply Co.
Martin Iron Works

CONCRETE PIPE MOULDS
Concrete Machinery & Supply Co.
Martin Iron Works

CONTRACTORS, WELL
Roscoe Moss Co.

COUPLINGS, FLEXIBLE
Byron Jackson Pump Mfg. Co.
Kelley-Connell Co.
Woodin & Little
De Laval Steam Turbine Co.

CRANES
Northwest Engineering Co.

DAMPPROOFINGS
Hill, Hubbell & Co.
Everlasting Paint & Sales Co.
Dearborn Chemical Co.

DITCH LINING MATERIAL
Crown, Bitumens Corp.

DRAGLINES
Northwest Engineering Co.

DRILLING RIGS
Armstrong Manufacturing Co.
Commercial Iron Works
Roscoe Moss Co.

DRILLING SUPPLIES
Armstrong Manufacturing Co.
Commercial Iron Works
Roscoe Moss Co.

ENGINES
Commercial Iron Works
Fairbanks, Morse & Co.
Western Machinery Co.
Woodin & Little

ENGINES, DIESEL
Western Machinery Co.
Fairbanks, Morse & Co.

FILTERS, WATER
International Filter Co.
Wallace & Tiernan Co.

FILTER PLANTS
International Filter Co.
Wallace & Tiernan Co.

FITTINGS, PIPE
Commercial Iron Works
Woodin & Little
McWane Cast Iron Pipe Co.
U. S. Cast Iron Pipe & Fdry. Co.

FLUMES, LENNON TYPE
Calif. Corrugated Culvert Co.

GATES, DRAINAGE & PRESSURE
Calif. Corrugated Culvert Co.

GAUGES & RECORDERS
R. W. Sparling

GEARS, WORM & HELICAL
De Laval Steam Turbine Co.

GREASE, TULC
Masterson, Jos. A. & Co.

HYDRANTS, FIRE
Kennedy Valve Mfg. Co.
A. D. Cook, Inc.
Michigan Valve & Foundry Co.

INDICATORS—PUMPING LEVEL
Commercial Iron Works
Kimball, Frank J. Co.

JACKS, HYDRAULIC
Commercial Iron Works

METERS, COMPOUND
Hersey Mfg. Co.
Neptune Meter Co.
National Meter Co.

METERS, CREST
Neptune Meter Co.
National Meter Co.

METERS, ELECTRIC
Westinghouse Electric & Mfg. Co.

METERS, FLOW
Hersey Mfg. Co.
Neptune Meter Co.
National Meter Co.
R. W. Sparling
Worthington Co., Inc.

METERS, WATER
Hersey Mfg. Co.
Neptune Meter Co.
National Meter Co.
R. W. Sparling
Worthington Co., Inc.

METERS, MAIN LINE
R. W. Sparling

METER DISCS
Hersey Mfg. Co.
National Meter Co.
Neptune Meter Co.
R. W. Sparling
Worthington Co., Inc.

METERS, TURBINE TYPE
Worthington Co., Inc.

MIXERS, CONCRETE
Concrete Machinery & Supply Co.
Martin Iron Works

MOTORS & MOTOR CONTROL
Westinghouse Electric & Mfg. Co.
Woodin & Little
Fairbanks Morse & Co.

OIL, LUBRICATING
Dearborn Chemical Co.

PIPE, CONCRETE
Bent Concrete Pipe Co.
Calif. Asso. Concrete Pipe Mfgrs.
Western Concrete Pipe Co.

PIPE, CORRUGATED
Calif. Corrugated Culvert Co.
American Steel Tank & Pipe Co.

PIPE, RIVETED STEEL
Western Pipe & Steel Co.
Los Angeles Mfg. Co.
Lacy Manufacturing Co.
Montague Pipe & Steel Co.

PIPE FITTINGS
Kennedy Valve Mfg. Co.
Michigan Valve & Foundry Co.
Kelley-Connell Co.
Commercial Iron Works
Woodin & Little
James Jones Co.

PIPE FITTINGS, BRASS
James Jones Co.

PIPE FITTINGS, BRONZE
James Jones Co.

PIPE & FITTINGS, CAST IRON
Pacific Pipe Co.
Los Angeles Mfg. Co.
Lacy Mfg. Co.
Fairbanks Morse & Co.
Montague Pipe & Steel Co.
McWane Cast Iron Pipe Co.
U. S. Cast Iron Pipe & Fdry. Co.
Pacific States Cast Iron Pipe Co.

PIPE & FITTINGS, CONCRETE
Associated Concrete Pipe Mnftrs.
Bent Concrete Pipe Co.
Western Concrete Pipe Co.

PIPE, STORM DRAIN
Associated Concrete Pipe Mnfrs.
Bent Concrete Pipe Co.
Western Concrete Pipe Co.

PIPE, CONCRETE PRESSURE
Bent Concrete Pipe Co.

PIPE DIP & COATINGS
Hill, Hubbell & Co.
Everlasting Paint & Sales Co.
Dearborn Chemical Co.

PIPE FITTINGS, MALLEABLE AND FORGED
Kennedy Valve Mfg. Co.

PIPE FITTINGS, SERVICE SPECIAL
James Jones Co.
Mueller Co.

PIPE & FITTINGS, WOOD
Pacific Tank & Pipe Co.

PIPE & FITTINGS, WROUGHT IRON
Pacific Pipe Co.

PIPE, LOCK BAR STEEL
Western Pipe & Steel Co.

PIPE, WELDED STEEL
Western Pipe & Steel Co.

PIPE, RIVETED STEEL
Western Pipe & Steel Co.
Lacy Manufacturing Co.
Los Angeles Manufacturing Co.
Montague Pipe & Steel Co.

PIPE, WOOD
Pacific Tank & Pipe Co.

PIPE CLAMPS
Philbrook Spring Pipe Clamp Co.
Mueller Co.

PENSTOCKS
Western Pipe & Steel Co.
Lacy Manufacturing Co.

PRESSURE SYSTEMS
Byron Jackson Pump Mfg. Co.
Fairbanks, Morse & Co.
Woodin & Little

POST INDICATORS
Kennedy Valve Mfg. Co.
Michigan Valve & Foundry Co.

PUMPS, CENTRIFUGAL
De Laval Steam Turbine Co.
Yeomans Bros. Co.
Lane & Bowler
Byron Jackson Pump Mfg. Co.
Fairbanks, Morse & Co.
Kimball, Frank J. Co.
Pacific Pump Works
Price, G. W. Pump & Engine Co.
Sparling, R. W.
Sterling Pump Works
Woodin & Little
American Well Works

PUMPS, DEEP WELL
Byron Jackson Pump Mfg. Co.
American Well Works
Price, G. W. Pump & Engine Co.
Pacific Pump Works
Sterling Pump Works
Luitweiler Pumping Engine Co.
A. D. Cook, Inc.

PUMPS, ROTARY
Woodin & Little
Fairbanks, Morse & Co.
Byron Jackson Pump Mfg. Co.

PUMPS, PLUNGER TYPE
Pomona Mfg. Co.
Woodin & Little
A. D. Cook, Inc.
Luitweiler Pumping Engine Co.

PUMPS, TURBINE
Sterling Pump Works
Price, G. W. Pump & Engine Co.
Pacific Pump Works
Pomona Mfg. Co.
Fairbanks, Morse & Co.
American Well Works
Lane & Bowler Corp.
Byron Jackson Pump Mfg. Co.
Kimball, F. J. Co.

PUMP VALVES
Pomona Mfg. Co.
Woodin & Little

PUMP HOUSES
California Corrugated Culvert Co.
Los Angeles Mfg. Co.

PUMPS, DRAINAGE
Byron Jackson Pump Mfg. Co.
G. W. Price Pump & Engine Co.
Woodin & Little

RESERVOIR LINING
Crown Bitumens Corp.

SERVICE COCKS
Mueller Co.

SEWAGE PUMPS, VERTICAL & HORIZONTAL
Yeomans Bros. Co.

SEWER PIPE
Associated Concrete Pipe Mfgrs.
Bent Concrete Pipe Co.
Western Concrete Pipe Co.

SHEAR GATES
Michigan Valve & Foundry Co.

SLUICE GATES
Michigan Valve & Foundry Co.

SOFTENING EQUIPMENT, WATER
International Filter Co.
Wallace & Tiernan Co.

STANDPIPES, STEEL & IRON
Los Angeles Mfg. Co.
Lacy Mfg. Co.
Montague Pipe & Steel Co.
Western Pipe & Steel Co.

STERILIZATION EQUIPMENT
International Filter Co.
Wallace & Tiernan Co.

SWITCHBOARDS
Westinghouse Electric & Mfg. Co.

TANKS, STEEL & IRON
American Steel Pipe & Tank Co.
Calif. Corrugated Culvert Co.
Lacy Mfg. Co.
Los Angeles Mfg. Co.
Montague Pipe & Steel Co.
Western Pipe & Steel Co.

TANKS & TOWERS
Pacific Tank & Pipe Co.
Western Pipe & Steel Co.

TAPPING VALVES & SLEEVES
Michigan Valve & Foundry Co.

TAPPING MACHINES
Mueller Co.

TAPPING MACHINE SLEEVES & VALVES
Mueller Co.

TRENCHING MACHINES
Ruth Dredger Sales Corp.
Bay City Dredge Works
Northwest Engr. Co.

TURBINES, STEAM
De Laval Steam Turbine Co.

VALVES, AUTOMATIC CONTROL
R. W. Sparling
Kelley-Connell Co.
Commercial Iron Works
Woodin & Little

VALVES, BUTTERFLY
Commercial Iron Works
Kelley-Connell Co.
Woodin & Little

VALVES, CHECK
Michigan Valve & Foundry Co.
Kennedy Valve Mfg. Co.
Kelley-Connell Co.
Byron Jackson Pump Mfg. Co.
Commercial Iron Works
Woodin & Little

VALVES, COMPOUNDING
Hersey Mfg. Co.

VALVES, FLAP
Byron Jackson Pump Mfg. Co.
Commercial Iron Works
Kelley-Connell Co.
Martin Iron Works
Michigan Valve & Foundry Co.

VALVES, FOOT
A. D. Cook, Inc.
Michigan Valve & Foundry Co.
Kennedy Valve Mfg. Co.
Kelley-Connell Co.

VALVES, GATES
Michigan Valve & Foundry Co.
Pomona Mfg. Co.
Calif. Corrugated Culvert Co.
Martin Iron Works
Woodin & Little
Kennedy Valve Mfg. Co.

VALVES, GLOBE
Kennedy Valve & Mfg. Co.

VALVES, PLUG
Michigan Valve & Foundry Co.

VALVES, SPRINKLER
Kennedy Valve & Foundry Co.

VALVES, WATER RELIEF
Neptune Meter Co.

WATER FILTRATION PLANTS
International Filter Co.
Wallace & Tiernan Co.

WATER SOFTENING EQUIPMENT
Dearborn Chemical Co.
International Filter Co.
Luitweiler Pumping Engine Co.
Wallace & Tiernan

WATER MAIN CLEANING
National Water Main Cleaning Co.

WATERPROOFING COMPOUNDS
Dearborn Chemical Co.
Everlasting Paint & Sales Co.
Hill, Hubbell & Co.

WATER WASTE SURVEYS
Smith-Emery Co.

WELL DRILLING CONTRACTORS
Roscoe Moss Co.

WELL DRILLING EQUIPMENT
Armstrong Mfg. Co.
Roscoe Moss Co.

WELL SCREENS
Luitweiler Pumping Engine Co.
Cook, A. D. Inc.
Lane & Bowler Corp.

WELL CYLINDERS
Luitweiler Pumping Engine Co.
Cook, A. D. Inc.

WELL SUPLLIES
Armstrong Mfg. Co.
Commercial Iron Works
Roscoe Moss Co.
Luitweiler Pumping Engine Co.
Cook, A. D. Inc.

The Vale Irrigation Project

(*Continued from Page 30*)

district to be used by the Vale project results from early overestimates of the irrigable area in the Warmsprings district. Seepage encroachments and refractory alkaline soils have reduced the amount of tillable lands in this district until at the present time about one-third of the original area of 37,000 acres classed as irrigable is capable of producing crops.

This reduction in area has reduced the resources of the district to such an extent that it is incapable of financing a drainage program. By the terms of the pending contract for purchase of the surplus Warmsprings Reservoir capacity, the United States will divert from $150,000 to $200,000 of such purchase money to provide drainage for the district lands, and without further consideration the Warmsprings district drains will also carry off drainage waters from the high-lying Vale project lands.

TOTAL COST $3,590,000

The total cost of the project is estimated at $3,590,000. Of this amount about two-thirds is required for the diversion weir and the main canal and approximately one-fifth for storage. The remainder of the estimated cost is required for laterals and drainage.

By means of a supplemental contract with the Warmsprings irrigation district it has been arranged that this district shall utilize the drainage and return flow from the Vale project lands to the greatest extent possible, with the Vale project receiving Warmsprings Reservoir storage in equal amount in exchange.

The total area commanded by the canals of the Vale project, not including lands now having a full water supply, is 36,000 acres. Soil surveys and a land classification indicate 32,095 acres thereof irrigable, for which 2,776 acres now receive a partial water supply from various sources.

With appropriate allowances for rights of way and equivalent areas of full water right in lieu of the area now receiving a partial supply, the net irrigable area would be equivalent to 28,350 acres receiving a full water supply.

This Firm Features Promptness

The De Laval Steam Turbine Company is making a record for prompt service. The Los Angeles office recently received a telephone message from Allan P. Rowe, engineer of the office of J. B. Lippincott, asking for a complete set of repair parts as soon as possible. Within thirty minutes the parts had been delivered.

CLEARFLOW

DEPENDABLE FOOT VALVES

CAN BE RELIED ON TO KEEP YOUR PUMPS PRIMED

Why allow your automatic pressure-system to run all night, when an inexpensive and reliable foot-valve will assure immediate pumping?

For sale by leading jobbers and dealers

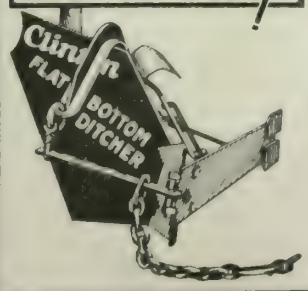
WRITE FOR CATALOG "A" 1926

Manufactured by

Kelley-Connell Company

1330 Second Street Berkeley, California

Make Your Ditch a Natural Water Course



Here are— 5 Advantages: you'll appreciate in this tool:

1. It builds a ditch which carries more water than a "V" ditch, depth and fall being equal.
2. The "off" horse walks on the flat ditch bottom instead of on the slope.
3. Silt fills this type of ditch more slowly and there is less overflow.
4. Erosion is minimized in the flat bottom ditch.
5. It can be cleaned out with greater ease for it keeps its shape.

For a descriptive folder and prices, write

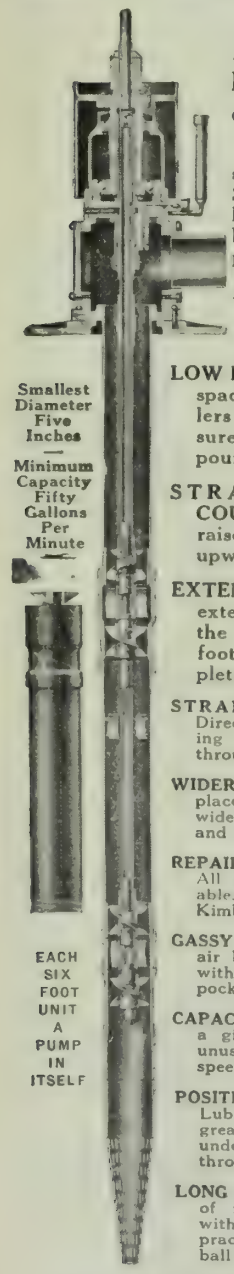
The Killefer Manufacturing Company

Box 606 Huntington Park, Los Angeles, Cal.

For Detailed Listings, Branch Offices, Etc., See the Buyers' Guide to Leading Supply Sources—Pages 99-100

IT'S NOT in the HEAD IT'S IN THE PUMP!!!

Mister Dealer
Mister Pump User



Here is news! Interesting News! For both of you.

Satisfaction assured to both the Seller and the Buyer. The Kimball story is complete—read it!

ADAPTABILITY. Large capacity from small well.

LOW PRESSURES. The spacing of the impellers reduces the pressure to less than three pounds at any part.

STRAIGHT WATER COURSE. Water is raised in a straight upward course.

EXTENDABILITY. All extensions made from the top. Each six-foot section a complete pump.

STRAIN DISTRIBUTION. Direct flow allows spacing of impellers evenly throughout the shaft.

WIDER RANGE. Semi-displacement permits a wider range of speed and capacity.

REPAIRS EASILY MADE. All parts interchangeable. Don't return the Kimball to the factory.

GASSY WELLS. Gas and air bubbles are raised with the water — no pockets to collect either.

CAPACITY. Greater from a given size well with unusually slow rotative speeds.

POSITIVE LUBRICATION. Lubricated with soft grease from the inside under high pressure, through hollow shaft.

LONG LIFE. Only the best of materials, combined with skilled engineering practices, go into Kimball Pumps.

Send Me Your Catalog No. 103.

Diameter of well.....inches
Depth of well.....feet
Distance to water.....feet
Draws down when pumping to.....feet
Lift above surface.....feet
Would like a capacity of.....gallons.

NAME.....

ADDRESS.....

FRANK J. KIMBALL CO.
1857 E. 15th St. Los Angeles, Calif.

Looking Backward—(*Continued from Page 13*)

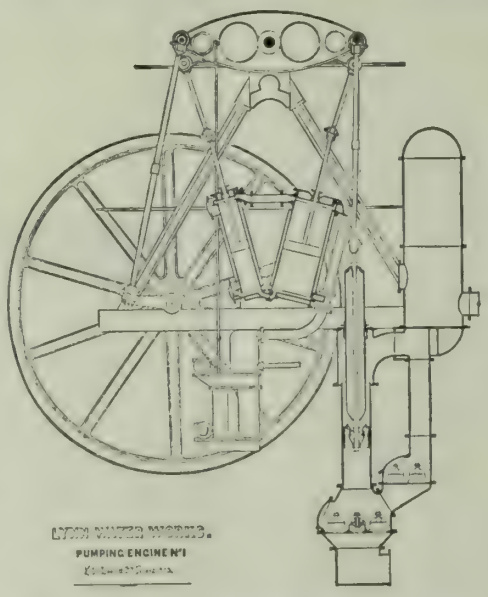
The famous Tea-water pump, from Costello's History of the New York Fire Department.

The fire box was made of wrought iron plates about 3 feet square. Most of them were imported from England. The flues were vertical and were made of cast iron through which the water passed. Steam pressure was from 2½ to 4 pounds per square inch. These wooden boilers rotted out in about seven years and were replaced by cast iron boilers.

THE INSPECTOR'S REPORT

Inspector Thos. P. Cope, Esq., took the stage from Philadelphia in the morning of July 3, 1800, and arrived at the Soho Works (North of Newark, N. J.) at noon on the next day, visiting the machine shops of Nicholas J. Roosevelt (capitalist and owner of the works) to inspect the engines being built for the Philadelphia Water Works.

The difficulties of making two boilers, one a wooden one, like that which was put in at Philadelphia, the other of sheet iron, on Bolton and Watts construction. The fly wheel is driven by a sun and planet motion and the shaft works three small pumps with common cranks."

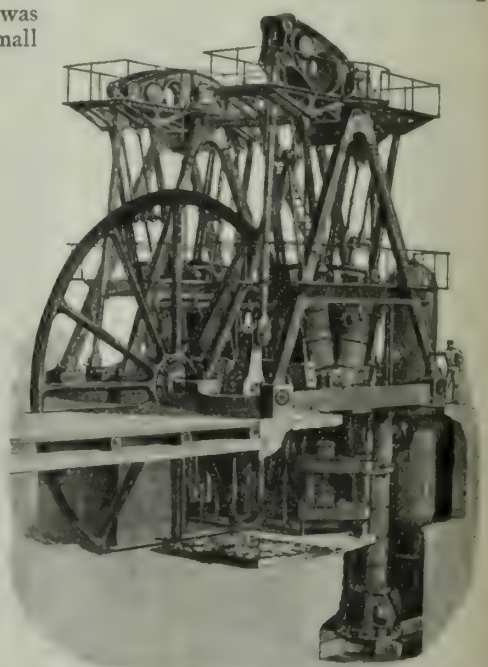


Lynn Water Works compound pumping engine, 1874. From Transactions Franklin Institute

In 1803 a second engine was purchased for $8,000, which allowed the eight horses and horse driven pumps to be retired. Each of these steam engines was 18 H.P., a size which is extremely small according to our present day ideas of power but which was the average of the engines of the day. This water system was in use until the Municipal water works went into operation in 1842.

The engines for the Philadelphia Water Works were manufactured by Nicholas Roosevelt during 1801 at his plant near Newark, N. J. There were two engines, one of 32-inch diameter driving an 18-inch pump, and the other 40-inch diameter driving a 17½-inch pump. The stroke of both engines was 6 feet. The lever beams, arms and shafts of the fly wheels, and even the boilers were made of wood. These wooden steam boilers were rectangular chests made of white pine plank 5 inches thick.

The boilers were 9 feet square and 15 feet long, braced on the outside with oak scantling and securely bolted together with iron rods passing through the planks.



Compound beam water works engine, from Transactions Franklin Institute, 1872

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the Roosevelt engines are set forth in an interesting report of July, 1800, by the inspector from Philadelphia: "All of the large cylinders are cast in two pieces and united by copper, the joints being secured externally by a strong iron band of cast iron weighing 1,200 pounds. 7,500 pounds of cast iron were used to make the cylinders. Two men were required to bore about ¾ of an inch from the castings; one almost lives in the cylinders with a hammer in hand to keep things in order and attend to the tools; the other attends to the frame on which the cylinder rests which is moved forward by suitable machinery; the work goes on day and night. One man is also employed to grind the tools which are changed every ten minutes. I examined some and found them worn ⅛ of an inch in that time. Three tools are fixed in the boring headpiece which is firmly secured to the end of an 8-inch iron shaft which has undershot water wheel on the other end. The boring of this cylinder commenced on the 9th of April; has been going on for the last three months and will take six weeks more to finish."

The records state further that after the cylinder was bored it was found to be at least ⅜ of an inch larger diameter in its middle than it was at the ends.

A Very Old Art

As shown by the four brief histories of the development of water works for these communities, the art is very old. Hero of Alexandria in 150 B. C., showed the principle of a force feed pump being used for fire engines, but undoubtedly it must have been utilized also for forcing water for fountains and other purposes as it is reasonable to suppose that the pump shown by him at this early period required a considerable number of years to develop in order to be as effective as indicated by his contemporaneous writers. The evidence we have from the ancient philosophers of Europe of the existence of small force pumps, with only slight detail changes from Hero's pump and used for fire and other purposes, shows that these pumps were well known and no doubt were frequently employed, especially among the older communities.

For more than 100 years after the lignum-vitae pumps at Bethlehem, Pa., were made, the same general form of force pump was used, driven by water wheels and later by steam engines.

The introduction of the steam engine early in 1800 brought about a considerable change in the problem of supplying water to our organized towns and the successful commercialization of these power units is demonstrated by the increase in the number of water works in America. At the close of 1800 there were 17 water works in the United States; this doubled to 34 in 1825 and there were 100 in 1850. This had increased to 243 in 1875, after which there was a very rapid growth and 1,000 water works are recorded in 1885. In the next 10 years this had tripled and by 1925 over 10,000 water works were registered.

Effect on Civilization

There has been a tremendous effect produced by the development of these water works systems. The standard of living and of safety and health of all people so supplied has been greatly benefited thereby. Whenever any of us dwelling in cities are deprived of water in our home or place of business, through an accident of some kind, the routine of our lives is entirely upset. It would require a very considerable readjustment if, instead of just turning a faucet to procure a profuse supply of hot or cold water, it should become necessary for all of us to take this water out of a well by an old oaken bucket or a more prosaic hand pump or to carry water in pails from some spring or stream.

In appreciation of the importance and convenience of our present water supplies, we should feel grateful for the early work of the men who not only developed this art, but who worked on the early steam engines and in machine shops in which these aids to civilization were produced.

The development of water works pumps, after the early steam engines had been applied to drive them, was rapid as is the growth of most mechanical appliances. The cheaper power produced by the compound and later the triple expansion engines allowed of the development of high duty pumping stations on a new basis of efficiency and capacity.

The development of these large pumps during this period was exceedingly interesting. Practically every community of any size had a show pumping station which consisted of a structure several stories high surrounding a slow speed engine operating innumerable pumps. This monumental mechanical structure was made of polished iron and steel with considerable brass work, and it contributed much to the mechanical knowledge of the youth of the day.

The lubrication of these early pumps and engines fit in with the historical development of lubricants. The first forms were lubricated by the animal and vegetable oils and fats, there being nothing of a complicated nature in either the machinery or the lubricants, and that which was available locally was quite sufficient for the work. As the plants became more complicated greater demands were made on the lubricants.

Perfect balance of the pump runners—an oiling system eliminating the danger of sand and water in the oil tube—superiority of materials with care and skill of manufacture—aid in producing the stability and long life of

Peerless Deep Well Turbine Centrifugal Pumps

Made for wells 7" or larger. Capacity 180-3000 gallons per minute.

What is the diameter and depth of your well, the standing water level and the total pumping head? Will you use Engine or Motor drive?

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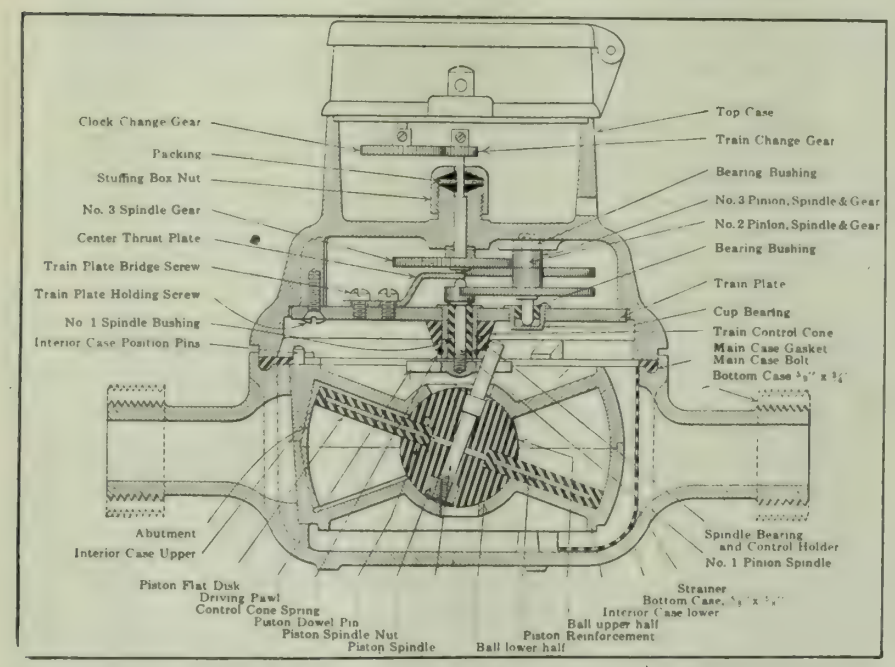
TRADE NOTES *of the* MONTH

UNIQUE TRAIN DESIGN FEATURES THIS WATER METER

By H. P. MATTE



Sectional Elevation of the 5/8-inch, 3/4-inch and 1-inch Worthington Meter with Enclosed Grease Train, Described in the Accompanying Article.

THE Worthington Model G. Meter has several features that are outstanding and unique, the most important being the design of the train, the frost and water hammer protection, interchangeability of train parts in all sizes, the use of Monel Metal in all parts subject to corrosion, and the adaptability of the same meter to both the open and enclosed train construction, with the option of the frost protection feature on either type.

Model G Disc meter was designed especially to prevent corrosion in all classes of service water. The questions of galvanic action, electrolysis, effect of sediment, and all form of foreign matter on gears were considered.

Only One Train Plate

Seventy years' experience in the manufacture of water meters gave an ample background.

The intermediate train has three gears of the same size giving a reduction in speed from the disc to the register of 166 to 1, resulting in extreme sensitiveness. The interesting and unusual departure from older designs is the fact that there is only one train plate in the meter. This, apart from reducing the corrosion hazards greatly simplifies maintenance costs because the train is not a separate unit. The removal of three Monel Metal screws releases the train plate and permits the displacement of the gears for examination and cleaning . The top plate or upper bearing is the meter body. If a new part is required it is easily placed into position without the necessity of a complete train.

The gears, pinions, spindles and train plates are interchangeable in all sizes. The train plates have capped rubber bushings, while the top bearings, also rubber bushed are capped by the top case. Thus, sand and other forms of sediment are kept from the bearings.

The Model G train is so constructed that the parts move freely with almost no friction. The thickness and diameter of the gears, the diameter of the spindles, the metal used in the wearing parts, the use of rubber bushed bearings, the arrangement of the various metals in the construction of the meter in the proper electro-motive serial placement, and the minimum number of parts; have all been considered carefully in order to reduce the corrosive factors, and to lengthen the life of the train.

Disc Chambers Described

The disc chambers are made in two sections. Care has been taken in the selection of the bronze to prevent galvanic action and increase the resistance to wear through the motion of the disc. In addition the disc or measuring chamber diaphragm is monel metal. All discs are made of hard rubber reinforced with metal in order to insure resistance to water hammer and other shocks. The spindle is also of monel.

The flow of water in this meter is direct from the outlet port of the measuring chamber; thus, capacity is increased to such an extent that the smallest meter, the 5/8" size is continuously being used in place of the older 3/4" meters. This is a material saving to the ultimate consumer.

Easy to Repair

The work of repairing a Worthington Model G meter is so simple that no mechanical ability is necessary. The tools required are a minimum—a screw driver and any wrench. It is impossible to make an error in assembling the parts. No particular care must be taken to place the gears in the proper sequence because the second and third gears are interchangeable, the first pinion is fastened to the train plate and is removed with it, and the third gear can fit only in the top case as the spindle passes through the stuffing-box. There is no intermediate pawl to adjust. An important point is the casting of the stuffing box into the top case. This eliminates another gasket and another point for leakage.

The main case is provided with a

round rubber gasket which fits into a groove in the bottom case. This guards against the blowing out of main gaskets under high pressures.

The Worthington frost protection feature is very effective and simple, too. It consists of a clamp made of a specially mixed metal and of a particular design to yield under the action of frost. One clamp is placed between the head of each bolt and the main case. This permits the separation of the two halves of the outer casing, and in the event of a severe frost or extreme separation, the disc chamber having no screws to keep the halves together will separate also without distortion. These clamps are also very useful in counteracting the effect of water hammer in contrast to a rigid breakable frost protection construction.

MEASURING "MUDDY" WATER

While the Worthington Model G meter fitted with an open type train has proved to be efficient under most conditions of service there are times when the meters are called upon to measure water which contains much sediment, iron or clay or even sand. It is evident therefore the wearing out of the moving parts will be accelerated. For this reason the oil enclosed train may be used to advantage. This is accomplished by substituting a solid train plate for the skeleton plate. When this change is made the entire working mechanism of the meter is separated from the service water.

In order to ward off corrosion a special oil is placed in the gear compartment. This remains on the gears and spindles and requires no further attention.

Model G meter is made in 5/8", 3/4", 1", 1½", and 2" sizes. The metals used in the construction are various bronzes and monel metal. Forged bronze bolts are provided for the main casing. The four screws in the interior of the meter are of monel metal.

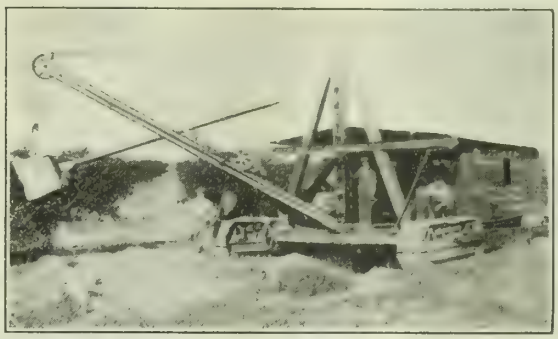
Business Men Finance Survey

Business men of Roundup, Montana, will advance the money necessary to make a preliminary survey to determine boundaries of the Lake Mason irrigation project, according to action recently taken by the Commercial Club. The cost of this survey is estimated at not to exceed $1,500. If the irrigation district is eventually created, the cost of the survey will be assessed against the land embraced in the district and the money now advanced will be refunded. Two independent projects are being discussed, the Lake Mason project, and the Musselshell river project.

For Cleanout -- Maintenance -- New Ditches

There's a Bay City for Every Job

BAY CITY Land Dredges span the ditch, can dig any desired slope, and dump waste on both banks. BAY CITIES leave clean, wide berms, and can work up or down streams. One trip over the ditch is enough. The Shovel Type Dipper handles hard material in which other types of buckets cannot make a good showing.



At left—One yard BAY CITY Dredge digging and cleaning ditches in Florida Citrus Groves.

BAY CITY Land Dipper Dredges are built to fit the job. Walking, Crawler, Track or Floating mounting. Easily dismantled, transported and assembled. Capacities ½ to 1½ cubic yards. Oil engine or electric operation.

FOR SMALLER DITCHES — OR PIPE LINE TRENCHES

The BAY CITY 16-B convertible Excavator will handle a wide range of work. Operates Dragline, Trench Shovel, Clamshell or Skimmer. All steel. Shipped assembled. Digs any width or depth up to 20 feet.

STEEL CONSTRUCTION

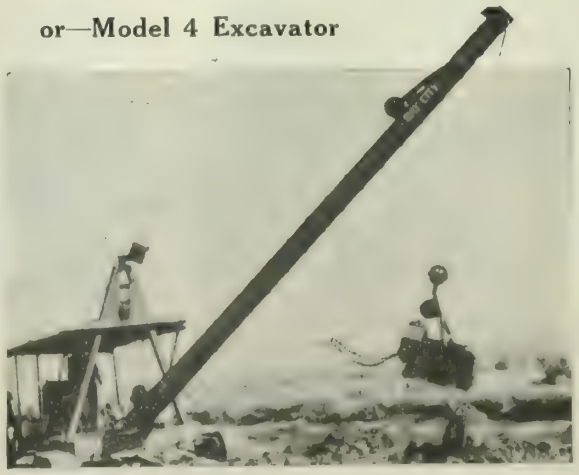
¾-yd. capacity

FULL CRAWLER MOUNTING

or—Model 4 Excavator

BAY CITY Model 4 is a small low-priced convertible, one-man operated Excavator. Fills the gap between hand labor and high priced equipment. Capacity 20 to 40 cubic yards per hour. Gasoline or electric power. A Real Digger economically designed for the small job. Also operates shovel, and clamshell.

WRITE FOR NEW CATALOG



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Our many years experience in manufacturing and operating Dredging machinery is at your service. Write us about your problem.

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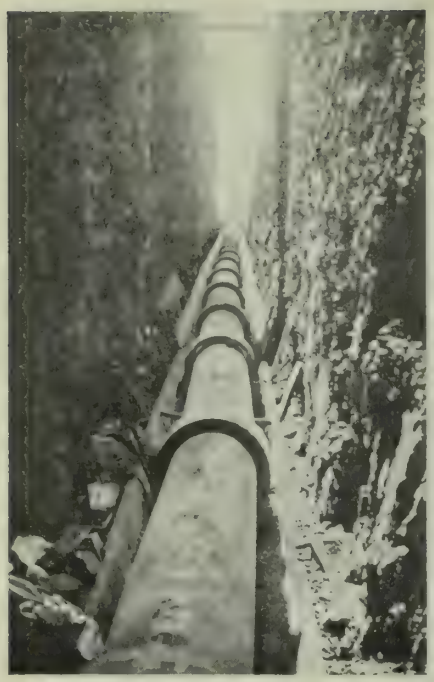


HIGH PRESSURE CONCRETE LINE

The photograph shows a 10-inch high pressure line of 120 pounds pumping pressure, which is being installed on the Captain Sills Spaulding Ranch, north of Santa Barbara, Calif. The ditch in this photograph is 16 feet deep and the pipe will have an overtopping of 30 feet. This high pressure concrete pipe is of recent manufacture, especially on the Pacific Coast. The Western Concrete Pipe Company is putting in several thousand feet of it on the Spaulding Ranch.

Issue Engine Bulletin

The Underwriters' Laboratories, which are maintained by the National Board of Fire Underwriters, have recently listed as standard, Climax "R4U" and "R6U" Engines for driving 750 and 1,000 gallon multi-stage centrifugal fire pumps. It is understood that these engines are the only medium speed, heavy duty engines to be so listed by the Underwriters' Laboratories.

A new bulletin describing these engines has just been issued by the Climax Engineering Company, Clinton, Iowa. Basically this engine is the same that has been previously used as power for cranes, shovels, gasoline locomotives, and kindred equipment. It has been equipped to meet the requirements of the Underwriters.

A. L. Graves, master mechanic of the Imperial Irrigation District has sent out an invitation to the ranchers of the district to visit the shops at any time. During the last year a number of lathes and other pieces of machinery have been installed so that it is now possible for the shops to do virtually all the repair work on district equipment.

Irrigation Equipment Shown at California State Fair

Pump Tent Houses Attractive Displays of Western Irrigation Equipment Association at Sacramento.

Farm machinery of every description, including pumps, pipe and other strictly irrigation equipment were displayed by manufacturers of equipment who were represented at the annual California State Fair, held in Sacramento the week of September 4th to 11th.

In what is generally referred to as

A general view of the 'pump tent" which housed the exhibits of the irrigation equipment manufacturers at the California State Fair.

One of the attractive exhibits, that of the Byron Jackson Pump Manufacturing Company.

The Price Pump exhibit

the Pump Tent, members of the Western Irrigation Equipment Association dominated the displays. Among the association exhibitors were W. R. Ames, manufacturer of surface irrigation pipe; Price Pump & Engine Co., who displayed a combination irrigation and pressure system connected to a deep well pump, and a 3,000 gallon double suction centrifugal pump.

Westco Chippewa Pump Company exhibited their pressure systems and plunger pumps, and Crane Company had a similar display of small pressure systems and household pumps.

The largest exhibit in the pump field was the comprehensive set up of the Byron Jackson Pump Mfg. Co., who displayed ten pumps of various sizes, some seven or eight of which were operating under pressure.

J. W. Bird was showing a new type of four cylinder deep-well pump. The pump exhibit of the Bean Spray Pump Co. was a deep well turbine pump.

Frank J. Kimball Company had two deep well pumps and two low-lift large capacity pumps. Two deep well turbines were the offering of the Western Well Works. The next booth occupied by the Pacific Pump and Supply Co., featured Meyers water supply systems and power sprayers.

A large display of motors, engines, pumps and farm machinery was grouped under the Fairbanks Morse & Company sign. The deep-well equipment manufactured by the Pelton Water Wheel Company was displayed in cooperation with the California Mechanical and Electrical Engineering Co. Concrete pipe and concrete farm and irrigation supplies were featured by the J. J. Merritt Co.

This completed the exhibit of those who were located in the pump tent. In various other locations around the fair grounds could be seen the exhibits of the Caterpillar Tractor Co., who displayed tractors ranging in size from the smallest to the largest models; the California Corrugated Culvert Co., who showed corrugated metal culverts, flumes, and irrigation gates, and the Trakford Co.

Automatic Gates Solve Problem

The Nevada Highway Department was faced with a difficulty recently, which, to the casual observer, would seem unlikely for a state usually thought of as very arid.

The Truckee Meadows in Washoe County are drained by what is known as the Peoples Drainage Ditch which empties into the Truckee River. During high water in the river, the water had a tendency to enter the Peoples Drainage

Thirty-six-inch automatic drainage gates draining Peoples Drainage Ditch into Truckee River, Nevada.

Ditch, reflooding the lands. However, the problem was solved by the installation of two thirty-six-inch Calco automatic drainage gates which allow all water being drained from the Meadows to enter the Truckee River, but at the first sign of high-water in the river, automatically close, preventing back-flow.

New Post for Utley

One of the interesting announcements of the last thirty days, in irrigation trade

C. A. UTLEY

circles on the Pacific Coast, was that of the resignation of C. A. Utley of the Pelton Water Wheel Company of San Francisco, California, to become president and general manager of the California Mechanical and Electrical Engineering Company of Sacramento.

Mr. Utley has been associated with the Pelton Water Wheel Company for many years in charge of the irrigation department and is one of the best known irrigation equipment men of the west, having been one of the organizers of the Western Irrigation Equipment Association, of which he was the first president. He has served this organization as secretary for the past several years and has been a strong personal factor in making it a constructive force in the irrigation world of the Pacific Coast.

Mr. Utley has announced his resignation as secretary of the W. I. E. A., in order to devote his entire time to the duties of his new connection but, inasmuch as the California Mechanical and Electric Engineering Company are members of the Association, he expects to continue to maintain a close interest in the organization.

San Francisco Survey Shows Urgency of Water Needs

(Continued from Page 41)

erty, the water requirement remains practically unchanged. The foregoing data substantiate this fact and indicate that the same rule holds for other California cities of similar kind including those in the Bay region. For communities with greater population density, however, the rule does not hold. San Francisco with a population density of over twice that of the built-up portions of Los Angeles has an acre use of approximately twice the local irrigation requirement, even though its present use is considerably below the average for American cities.

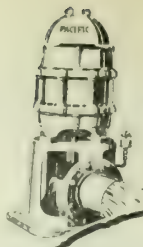
Similarly, in the congested portions of Los Angeles the use is considerably in excess of the irrigation requirement. As the larger California residential cities increase in population density or the nature of the water requirement is modified, there will undoubtedly be a departure from the present rule. For residential districts, however, the rule will probably not be modified. The analysis above shows clearly the limitations within which the urban water requirement per acre can be considered as identical with that for irrigation.

The intensively developed portions of the San Francisco Bay metropolitan area will presumably consist ultimately of the two densely populated centers of San Francisco and Oakland, surrounded by industrial and residential sections. Smaller centers will occur at more distant points, such as San Jose, Palo Alto, San Rafael, Vallejo, Santa Rosa, Napa, Martinez, etc., and in the intervening regions will be industrial districts, suburban residential sections, and rural areas.

Water for irrigation is required throughout the Bay region, both for beautified country estates and intensive agriculture. Industry also requires large amounts of water, the amount being indicated for a selected district in Los Angeles in Table 2. It may be assumed, therefore, that in its ultimate state of development practically every occupied acre of the 876,000 acres of the metropolitan area will have a potential demand for a reliable supply of water.

How Demand Was Estimated

In determining the probable total future demand for water in the Bay region all available data of water consumption were considered, including those presented above. The local conditions of the different communities as they affect water consumption were also considered, such as relative cost of distributing, use for gardens, industrial use, etc. The



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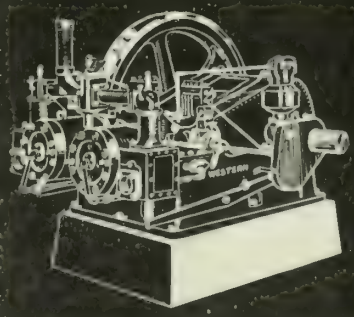

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probable nature of future development, whether urban, suburban, industrial, or agricultural, was also taken into consideration. In San Francisco, for example, it is believed that, although the use of water per capita as well as per acre will increase considerably over the present rate, yet because of the inherently high cost of delivering water to this area, and the comparatively small use for gardens, it will never reach the average for American cities with similar density of population.

In the East Bay region, however, it is believed that, with the provision of an adequate supply resulting in increased industrial and garden use, the present delivery per acre will almost treble and the per capita consumption be doubled, bringing the rate up to the average for American cities in the same class. The demand for industrial and agricultural purposes was also assumed in accordance with the data presented above.

In the North Bay region and in Livermore and Amador valleys, it is believed that there will always be about thirty-three per cent of the agricultural land not using water, the owners either preferring to dry-farm in certain years, or to rotate and allow a portion of the land to lie fallow each year. The result of the determination of the ultimate demand for water for all purposes in the San Francisco Bay metropolitan area indicates a total of 1,074 million gallons per day. The details of the estimate are shown in Table 3.

Future Sources of Supply

Development of local water resources to meet the growing demands of the Bay region will naturally continue until a limit is reached. This limit will be controlled by the relative cost of developing local and distant sources. The water-bearing gravel beds immediately surrounding the Bay and in the adjacent valleys have already been fully developed by means of wells and pumping plants and cannot be depended upon for additional supply. In fact, in most localities they are being overdrawn, and in the near future their use must be temporarily discontinued until the depleted reserves have opportunity to recover.

The unregulated winter run-off from rainfall on the productive watersheds immediately tributary to the Bay is the only remaining local source of undeveloped water. Storage must be constructed to conserve this water, either by collecting it in surface reservoirs or causing it to be absorbed by the porous gravels underlying the valleys. The great cost of the necessary lands and the construction which is required is a limiting factor in the supply. Run-off differs in amount from year to year, and periods of several years in succession occur when there would be no additions to reservoir supply. A large percentage of any additional reservoir capacity must thus stand idle for extended periods of time unless capable of being utilized for storage of water from distant as well as local sources. In a few instances this is possible, an example being the Upper San Leandro Reservoir now being constructed by the East Bay Water Company.

Sources of Further Supply

The watersheds of local streams tributary to San Francisco Bay are shown on Plate 1, together with lines of equal annual rainfall. The productive drainage areas, where storage sites are developed or proposed, are indicated by heavy shading. These lie within the areas of heaviest rainfall. The most important areas capable of further development by storage are those drained by Lagunitas Creek in Marin County, Los Gatos and Coyote creeks and other smaller streams in Santa Clara County, and by Alameda Creek. The latter is controlled by the Spring Valley Water Company, and its further development will augment the supply of San Francisco. The other streams are controlled by local agencies and will be used locally.

The East Bay and Peninsula regions are without local resources to meet the needs of their rapidly growing urban population, and development in the valleys of Sonoma, Napa, and Solano counties has practically reached the limit of local sources. By expensive conservation works considerable additional water can be developed in the Santa Clara Valley, but concerted action is necessary to accomplish this. Thus far all efforts made to organize a local district have failed.

The amount of water now developed from local sources for the supply of communities in the future metropolitan area is approximately one hundred million gallons per day. Agencies within the present metropolitan district are supplying eighty million gallons per day, and in the surrounding areas the San Jose Water Company, Port Costa Water Company, Bear Gulch Water Company, Petaluma Water and Power Company, Napa City Water Company, and the cities of Vallejo, Palo Alto, Redwood City, and other agencies are furnishing an additional twenty million gallons per day. Most of these agencies have reached the limit of their local sources and some are already drawing heavily upon reserves.

The Spring Valley Water Company on Alameda Creek, the San Jose Water Company on Los Gatos Creek, and the Marin Municipal Water District on Lagunitas Creek still have undeveloped sources which can be made available by storage of winter run-off. The Spring Valley Water Company development at Calaveras Reservoir is the largest single additional unit. Smaller additions might be made on other streams. The amounts which could be thus made available are variously estimated, being controlled to a large extent by economic considerations.

It has been conservatively estimated that sixty million gallons per day, in addition to the present developed supply, could be obtained by complete storage of winter run-off in streams which are available to existing agencies. The resources of the Santa Clara Valley, if comprehensively developed by a district embracing the entire valley, might bring up the total supply for this valley to ninety million gallons per day. The total possible local development would then be 250 million gallons per day as compared with the ultimate total demand of over one billion gallons per day. It is obvious that large quantities of water must be brought in from distant sources if the Bay region is to grow to its ultimate possibilities.

The various Sierra streams, the Sacramento and San Joaquin rivers near the head of Suisun Bay, and the Eel River, are the important distant sources of supply. Three of these have already been definitely selected. Construction work is in progress by the East Bay Municipal Utility District on a system to bring an emergency supply of fifty million gallons per day from the San Joaquin River. Later this system is to be extended and a permanent supply of 200 million gallons daily developed on the Mokelumne River. This system has the location and elevation which will enable it to serve not alone the territory now served by the East Bay Water Company in Alameda County including Richmond and El Cerrito, but the Bay shore and interior valleys of Contra Costa County. The immediate plans of the District are to serve the area now covered by the East Bay Water Company system, with extensions into other areas as the demand occurs.

Hetch Hetchy Project

The city of San Francisco has been actively pushing construction on the mountain divisions of its Hetch Hetchy project on the Tuolumne River, and is preparing to start work in the Sierra foothills. This project is so laid out that when built it could serve the Peninsula, the whole southern end of the Bay, and the East Bay region, as well as the present city and county of San Francisco. The supply which can be developed under the rights which the city owns has been variously estimated, and has been found by several independent determinations, including a detailed study made by the writer, to be from 375 to 400

TABLE 4

RELATION OF FUTURE WATER SUPPLY TO DEMAND FOR SAN FRANCISCO BAY METROPOLITAN AREA

(In Million Gallons per Day)

Region	Ultimate Demand	Ultimate Local Supply	Deficiency in Local Supply	Distant Sources	
				Location	Amount
North Bay	295	30	265	Eel River	200
				Russian or Sacramento River	65
East Bay cities	144	37	354	Sacramento-San Joaquin River	.....
East Bay shore and interior valleys	245			Mokelumne River	200
				Hetch Hetchy	154
San Francisco City and County	84+	80	4+	Hetch Hetch	20
Peninsula	99	15	84	Hetch Hetchy	84
Santa Clara Valley	207	90	117	Hetch Hetchy	117
Total	1,074	252	824		840

million gallons daily. It may be conservatively stated that the dependable Tuolumne River supply available to San Francisco under its rights, and in excess of the local irrigation demands as limited by economic requirements, is not less than 375 million gallons daily.

This assumes, however, that San Francisco proceeds continuously and diligently in the prosecution of construction work on its water-supply project, of which there still remains to be completed the Sierra Foothill, Valley, and Coast Range divisions.

The nucleus of a project for development of the Eel River has been completed by the Snow Mountain Water and Power Company by the construction of the Van Arsdale and Pillsbury reservoirs. The water level at the latter can now be raised to 110 feet above the stream bed with flash boards placed upon the dam. It is proposed to raise the dam to a height of 150 feet. This source is nearest the North Bay valleys, and in the proposed plan of the State Engineer for comprehensive development of the water resources of the state, has been indicated as the most feasible one for this region. It has also been considered as a possible source of supply for the Bay shore of Contra Costa County and the East Bay region. The dependable supply, with a 150-foot dam at Pillsbury Reservoir, has been estimated at from 168 to 250 million gallons daily, and for the purpose of this paper will be assumed at 200 million gallons per day.

Still Not Enough

It is apparent from the above, that the three projects already initiated to bring in water from distant sources, if consummated to the full extent proposed, would barely supply the future demands of the Bay region even with a full development of local sources. The Eel River supply with a higher dam at Pillsbury, is insufficient for the future needs of the North Bay region, and will have to be supplemented either by further development on other branches of the Eel, or by water from the Russian or Sacramento rivers or both.

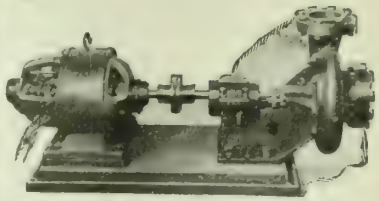
The proposed Mokelumne supply, although sufficient for the future needs of the East Bay cities, is far from being enough to supply the adjacent regions such as the Bay shore north of Richmond and south of San Leandro, and the interior valleys of Contra Costa and Alameda counties. The East Bay region will ultimately have to draw upon additional sources, the Hetch Hetchy project being the logical one for southern Alameda County and the Sacramento-San Joaquin River supply for Contra Costa County.

Situation Summarized

The city and county of San Francisco, as long as it is dependent entirely upon local sources, will periodically face periods of drought which will threaten the continuity of its supply. The rainfall of the past eight years has been below normal, and ground storage has become so depleted that the run-off of the past two years has been little or nothing. With the experience of the past few years the city cannot longer afford to gamble upon the continued adequacy of local supplies.

Table 4 briefly summarizes the water situation, and indicates in figures the relations of supply and future demand in the various subdivisions of the Bay region. The conclusion may be drawn that the fully developed local sources and the three definitely initiated distant sources will all be required. A supply from the winter and spring flows of the Sacramento-San Joaquin rivers will also be necessary. The latter may be considered only as an auxiliary and reserve supply, but in view of its relatively low cost and the efficiency of modern filtration methods, it might ultimately become one of the major supplies.

GOULDS PUMPS



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WHO'S *WHO* AND WHO'S *WHERE*

IN THE WORLD OF HYDRAULICS

Personal Notes and Impersonal Observations About Men You Know

Homer J. Gault has been appointed construction engineer on the Stony Gorge Dam on the Orland project, California.

Assistant engineer R. R. Robinson, formerly connected with the Salt Lake Basin project, has been transferred to the Kittitas division of the Yakima project, Washington.

Associate engineer A. C. Jaquith, who has designed several large dams for the reclamation bureau, has resigned his position with the Denver office of the bureau and has accepted a similar position in Mexico.

Assistant engineer J. H. Yates and Superintendent L. E. Foster, of the Carlsbad project, New Mexico, recently made a trip through the upper part of the Gallinas watershed on matters relating to the Pecos River adjudication.

Harry N. Jenks, who has been for some years superintendent of the pumping and filtration works at Sacramento, California, has gone to Iowa State College, Ames, Iowa, as associate professor in charge of sanitary engineering subjects.

J. L. Savage, designing engineer of the reclamation bureau, has recently been on the Kittitas division of the Yakima project, Washington. He was studying principally the problems affecting the construction of the next ten miles of the main canal.

M. T. Clemans, president of the Florence-Casa Grande Water Users' Association, Arizona, has sent out a statement urging that all contracts asking for inclusion of lands within the San Carlos project be signed and sent to the Florence office at once. "The Indian service officials," he says, "asked that all contracts be in as early in October as possible so that congress and the budget committee could not feel that there was any hesitancy on the part of land owners toward signing up—a condition that might cause unnecessary delay."

Attorney Samuel J. Flickinger, of the division of irrigation, Department of the Interior, attended a meeting held in Florence, Arizona, the latter part of September between the board of directors of the Florence-Casa Grande Water Users' Association and the officials of the Indian Service. Mr. Flickinger was in the valley making a personal inspection of the progress being made in project matters.

Representative A. M. Wyant, of Pennsylvania, visited Los Angeles the latter part of September on a nation-wide tour of inspection of government public works, agricultural districts and waterways. In an interview here Mr. Wyant declared himself in favor of the Columbia River project, of the development of the Colorado River, and of river improvements. "I believe the Boulder Dam project is necessary for the development of the resources of this district," Mr. Wyant stated.

A. L. Wisker, general manager of the Nevada Irrigation District, and Fred H. Tibbetts, chief engineer, had as their guests on a three-day trip over the Mountain Division of the district early in September twenty-four members of the Sacramento section of the American Society of Civil Engineers. The party left Sacramento on a Saturday noon and went by way of Grass Valley to Bowman Lake where they spent Saturday and Sunday nights. From here side trips were made to the various parts of the project.

George S. Hinckley, city engineer of Redlands, California, was the principal speaker at a recent meeting of the water users of the Hemet-San Jacinto Valley water system. Mr. Hinckley stressed the fact that a community can grow only as the water is developed for the use of that community. He stated that people are beginning to learn that by pooling their interests more water can be developed, and they are learning also that long drawn-out litigation does not provide any more water and usually results in a disadvantage for all concerned.

J. C. Bradbury, who is in charge of operations on the proposed Walnut Grove dam on the Hassayampa river, in Arizona, reports that work on a diversion channel, 329 feet in length, and for about half of the way drilled through solid rock, has just been completed. This channel is to carry water from the river bed away from the base of the dam which is to be constructed. Preliminary surveys have been made for an upper and a lower dam, about 24 miles apart. A storage capacity of 60,000 acre feet of water for each dam will reclaim approximately 20,000 acres of land, now used for grazing purposes.

E. C. LaRue, of Pasadena, California, hydraulic engineer of the United States geological survey, with an expedition of eight men is conducting a survey of the Little Colorado, one of the important tributaries of the Colorado River. The region now being surveyed by the engineers has been entered only once before by a party of white men, and the work is being carried on in the virgin territory under tremendous handicaps. Quicksands are prevalent in places, and for this reason the party is equipped with light sand-sailboats to transport the men and supplies across the treacherous sands. The present government survey is the first that has ever been made in the Little Colorado..

Louis C. Hill, formerly supervising engineer of the Bureau of Reclamation, stopped at the El Paso office of the Rio Grande project on his return from a trip to Mexico. Mr. Hill is one of the members of the board of engineers who will review all hydrographic and geologic data pertaining to the feasibility of the proposed new dam site between Avalon and McMillan reservoirs on the Carlsbad project, New Mexico. Mr. Hill will represent the interests of the water users at Carlsbad and Ft. Sumner. The other members of the board are S. O. Harper, assistant chief engineer of the bureau, who will represent the bureau; and Oro McDermith, who will represent the Secretary of the Interior.

Marcelo Leon, an engineer with the Mexican Government, was a recent visitor to the Boise project, Idaho.

S. O. Harper, general superintendent of construction, bureau of reclamation, has recently visited a number of the projects in the northwest.

Charles E. Scott, El Centro, California, represented the Imperial Valley associated chambers of commerce at the Winning the West Conference, held in Los Angeles, October 14 and 15.

Andrew Weiss, assistant director of reclamation economics, has resigned his position with the bureau of reclamation to become associated with J. G. White Engineering Corporation in Mexico.

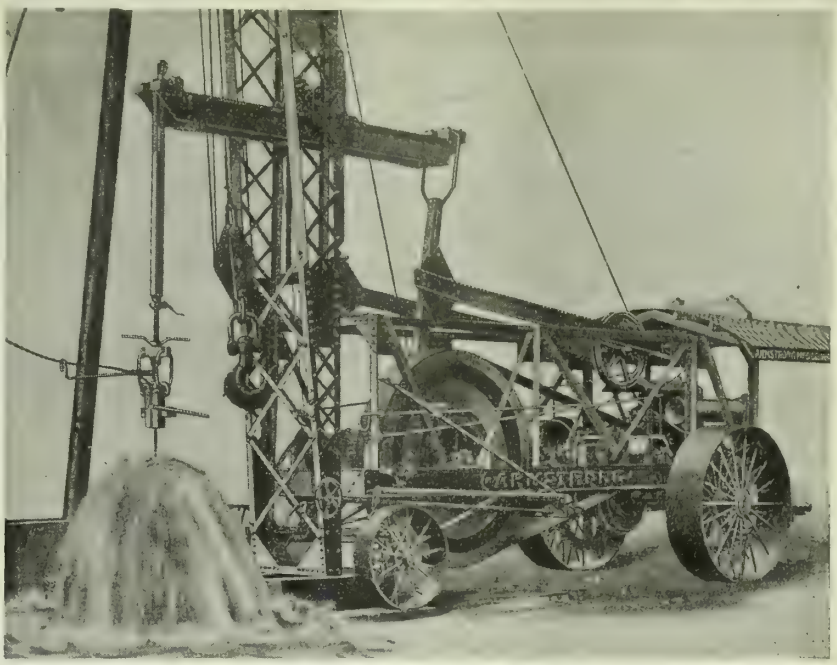
Major C. R. Olberg, assistant chief engineer of the Coolidge Dam, San Carlos project, Arizona, discussed the features of the dam's proposed construction before the delegates to the Winning of the West convention in Los Angeles on October 15.

Former Governor Thomas E. Campbell, recently chairman of the fact-finding commission, has been overseeing the technical details and historical data concerning the development of the Colorado River and reclamation work in connection with the filming of a new motion picture.

Dr. John A. Widtsoe, who was one of the principal speakers at the meeting of the Montana Irrigation and Drainage Institute, held at Valier, Montana, made a brief inspection of the Greenfields division of the SunRiver project while on his way from Valier to Great Falls.

Maurice G. Ricker, photographer and editor of motion-picture films, has returned to the Washington office of the Bureau of Reclamation after an extensive trip over a number of the irrigation projects. During the course of the trip he took more than 1,000 still pictures and about 15,000 feet of motion pictures.

Harry Lee Martin was elected president of the Tulare Lake Basin Water Storage District at a meeting of the directors held at Hanford, California, on October 6. The district is working for the development of a storage reservoir in the basin of Tulare Lake, with an area of some 20,000 acres, to take care of excess water in flood years and to hold in reserve surplus waters for irrigation.



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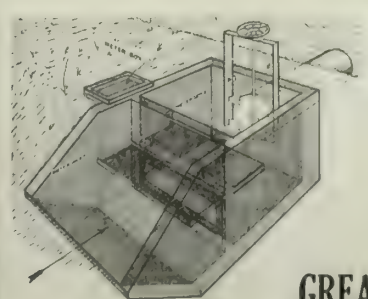

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Claimant Need Not Publicly Announce his Adverse Claims

Whether claim of an easement for a ditch is adverse or merely permissive is a question of fact.

In the case of Stetson vs. Youngquist 248 Pac. Rep. 196 (July 8th, 1926) the plaintiff claimed the right to the use of a ditch crossing the defendant's lands. The plaintiff purchased his land in 1909 and constructed the ditch in 1911. The ditch was used from that period and no direct objection was made to its use and no direct claim of right, other than the use, was made by the user.

In 1925 the relations between the parties became somewhat strained and defendant refused to allow plaintiff further use of the ditch. Plaintiff claims an adverse and prescriptive right to the perpetual use of the ditch and defendant claims that the use was merely permissive and therefore a revocable license.

In reviewing the law and the facts and in giving judgment for plaintiff the Supreme Court of Montana, states:

"Plaintiff constructed his ditch upon defendant's land on the theory that he had the right to do so and has ever since maintained the ditch there. He has shown an open, visible, continuous, and unmolested use of the ditch for the period of time sufficient to acquire title by adverse possession. In the absence of any evidence on the subject, the use under such circumstances, is presumed to be under a claim of right and not by license of the owner. In order to overcome this presumption, thereby saving his title from the incumbrance of an easement, the burden is upon the owner to show that the use was permissive. When the claimant's use has been thus open, continuous, unmolested and under a claim of right, it is deemed to have been adverse to the owner. . . . . If the character of the possession is such that a claim of ownership may be inferred therefrom, and is open and notorious, it is hostile. It is not necessary that one should expressly declare his possession to be hostile, or that his use of the premises should be such as to indicate at all times a hostile occupancy. . . . the question of adverse possession is one of intention. The intention must be discovered from all the circumstances of the case."

Utah Ruling on Suit to Adjudicate Water Rights

All users must be made parties to suit; findings of court must be definite and certain.

In the case of Garner vs. Anderson 248 Pac. Rep. 496 (June 4th, 1926) the trial court attempted to adjudicate the water rights on a small mountain stream known as Burch Creek. Certain water users were not joined, the decree did not allot definite amounts to various owners of lands and opinion evidence was allowed as to the amount necessary to irrigate certain lands with no showing of the qualification of witnesses to testify to such matters.

In reversing the judgment of the trial court, the Supreme Court of Utah states:

"We do not wish to be understood as holding nor do we hold, that a farmer or other who has had experience in actually irrigating lands cannot give his judgment, if he has any judgment, as to the quantity of water necessary to irrigate particular lands. The difficulty with the witnesses in this case is that they stated they had never measured water, did not know or claim to know, the actual amount of water used in the irrigation of their individual lands or the lands of other parties to the action. At most it was a mere guess as to the quantity of water necessary for the irrigation of either respondent's or appellant's lands. . . . . .

If it were the theory of the plaintiffs that others not parties to the action were entitled to the use of the waters as tenants in common, such fact, in the absence of pleadings and in the absence of the parties, would deny the court the right to make such adjudication. . . . .. Any judgment consented to by the parties before the court would in no way affect the rights of the others not parties to this proceeding. . . . . There is not sufficient data in the record from or by which this court can determine the rights of the plaintiffs or the defendant in the waters of the creek. The number of acres irrigated by the plaintiffs and which they have a right to irrigate is not very conclusively proven. There is no map or other record from which or by which a reviewing court can get an intelligent idea of the acreage or its location to other parts of the land claimed by the plaintiffs or by "others not parties to the action" . . . Plaintiff's rights to the water, as indicated, are established, but the quantity of water to which they are entitled is not established. . . .

New Mexico Irrigation Bonds Payable Outside State

Laws of New Mexico do not follow the conclusions of the Supreme Court of California.

In the case of Davy vs. Day 247 Pac. Rep. 842 (June 17, 1926) an objection is raised to the issuance of bonds of the Bluewater-Toltec Irrigation District, which bonds are proposed to be made payable either in New Mexico or New York.

In supporting the provisions making such bonds payable in New York, the Supreme Court of New Mexico states:

"The whole argument of appellant is based upon the provisions of Sec. 10 of Article 8 of the Constitution, which is as follows:

'All public moneys . . . . shall be deposited in national banks in this state. . . .'

The argument is made that, in order to pay a bond, made payable at any place, it will be necessary to deposit public moneys at such place to effectuate that result. Therefore, it is argued, in order to pay a bond made payable at some bank in New York, for instance, it would be necessary to deposit the public funds with such bank for such purpose. This is clearly a misconception of the sense in which the word "deposited" is used in the Constitutional provision above quoted. The provision is one for the safe keeping of the public funds while the same are not being used for the public purposes. It is not designed nor intended to hamper or prevent the doing of the business of this state according to the methods employed throughout the business world. . . . . When they (funds) are required to meet the public obligations, they may be expended in a business way, and according to business methods and practices.

Counsel cites and relies upon Los Angeles v Teed 112 Cal 319. The case is in point and sustains the contentions of appellant. While we have uniform respect for the decisions of California, we are compelled to decline to follow this one as unsuitable to our situation and the policy of our laws."

Irrigation Taxes Are Special, Not General Liens.

Under the Colorado Irrigation District Laws, District Assessments cannot be cumulated.

In the case of Thomas vs. Henrylyn Irrigation District 247 Pac. Rep. 1059; (July 6th, 1926) the Supreme Court of Colorado follows the rule of law enunciated in the case of Interstate Trust Company vs. M. V. Irrigation District, (181 Pac. 123) called "the Montezuma Case" also a Colorado case, and holds as follows:

"In the Montezuma Case we held that taxes levied under the act are not general, but special; hence there could be no cumulative levy, and the holder of warrants was confined to the proceeds of the regular levy and sale. If taxpayers are delinquent, he may use his warrants to buy at the sale and procure deeds on his certificates; he could not demand a new levy and thus pyramid the debt of those who do not pay on the lands of those who do. It is here contended that the Montezuma Case is not in point, because there warrants were involved and here bonds and coupons. The control-

(*Continued on Page 96*)

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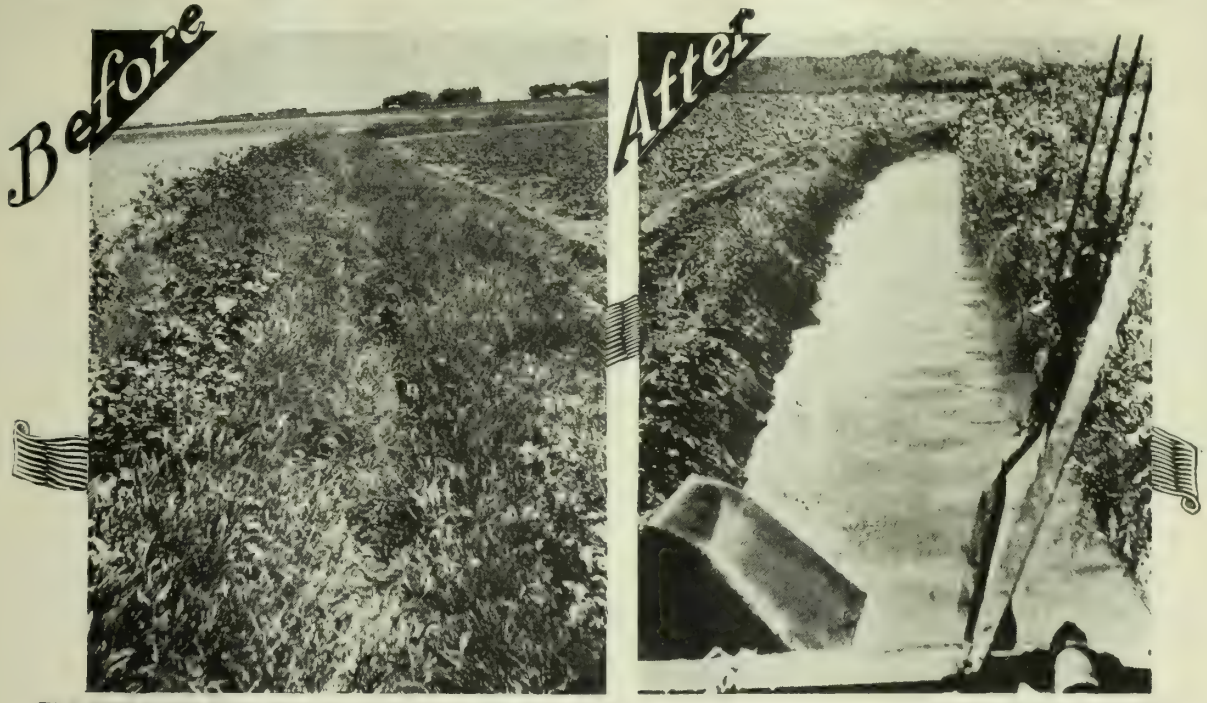

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We have a lot of this necessary water in the Colorado River flowing on its way to the sea. It's only a matter of human endeavor, judiciously expended, to bring this water to the land, then to apply it in the most economical form such as is possible by using the overhead system, this system leaving the precipitation of the moisture absolutely under control regardless of the topography of the land, or the nature of its soil.

Used on Irregular Land

Until the introduction of the overhead idea, it was very much of a hit and miss proposition to irrigate sandy soil or irregular ground and there was a deplorable waste of water. The labor entailed in the leveling of the land for furrow irrigation was in itself no small item and was far from satisfactory at best, necessitating as it did in many cases the stripping of the good top soil from some places to fill the hollows in others, which already had their proportion of good top soil. The foregoing proceeding is entirely eliminated by the new method and the irrigation can be applied scientifically and with accuracy.

Where the soil is sandy or light the irrigation can be applied lightly and often, or where of a heavier nature can be adjusted so as to give the ground just the proper amount of water that it is capable of absorbing without running off.

It has been found that overhead irrigation is very helpful in the condition commonly known as "ploughsole" as the water applied this way becomes impregnated with air bubbles which are carried down into the soil, loosening it and delivering their chemical components up to to the soil, an advantage that has long been recognized from our experience with natural rain.

The question has often been raised as to the merits of the system as protection against frost. This phase is still in an experimental state. However, it seems justifiable to conclude, that if the water is turned on during the daytime when a freeze is expected that it will absorb enough sun heat and carry it into the soil, to be given out during the night, to go a long way towards preventing damage; but it is a rather risky experiment to turn the water on as the freeze is in progress, especially if severe, for if the water is not put on faster than it can freeze, it will form ice on the trees and eventually break down the limbs, doing more damage than otherwise.

Eliminates Dust

Overhead irrigation where applied has proved very acceptable not only to those who have to work in the groves, but is blessed by many of the good housewives living close by, as it has practically eliminated the dust nuisance. It also leaves the groves clean and pleasant to enter with the tools.

The writer has before him a quotation from a letter from one of our highest agricultural authorities written back in 1923 in which he says of overhead irrigation:

"The higher the water is thrown the greater the amount of gas absorption from the air will be accomplished. Air oxygen, ammonia gas and dust particles can all be ranked as fertilizing elements and applied directly to the soil itself. This type of irrigation will create moisture which is the real scientific meaning of irrigation i.e. artificially supplying to the soil moisture necessary to agricultural production; and it will supply it at the minimum water expenditure. However its application must be strictly scientific and it would be a vain effort to apply overhead irrigation where the sub-strata is not first made contiguously moist from the impervious strata below to the top of the soil."

Conserves Water

The contentions of this authority made before the overhead idea became an accepted fact, as it is today, are very interesting inasmuch as they have been fully borne out by practical experience gained since that time.

The conservation of water by the new method of irrigation is a very important factor, and taken alone would in many cases warrant its adoption. In looking broadly to the future it is safe to predict that overhead irrigation is with us to stay, and is destined to prove a great boon to the agriculturist and consequently to the world at large.

Limoneira Tests "Overhead"

Reports from the Limoneira Ranch, Santa Paula, California, tell of experiments being tried with overhead irrigation, but state that the system has not yet been in use long enough to compare that system thoroughly with the furrow system. Lemon fruit measurements on large Lisbon trees, says Charles A. Jensen, superintendent of the ranch, showed that the overhead irrigated trees grew lemons about two packing sizes larger than the adjoining trees furrow irrigated, from April 28 to October 6.

On the whole, the amount of water applied in the overhead system in the grove with very large trees was about one-half the amount applied in the furrow system, but this difference is due to the readiness with which the soil takes water. By the furrow system it is practically impossible to get the lower end of the runs wet enough without applying more water than the grove as a whole needs. On the other hand, the overhead system may not be as economical of water in the groves with half grown trees, because the whole soil necessarily gets irrigated whether it needs it or not.

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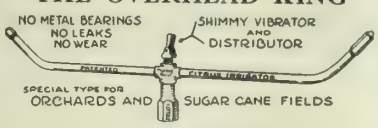

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Irrigating Vegetable Crops

(*Continued from Page 19*)

moisture from the soil is proportional to their leaf area hence the need for water is greater as the plants grow larger. As the surface of foliage increases more water will be required to replace the increasing amounts which are constantly being transpired by the bigger plants.

The appearance of the plants is often used as an indicator of the moisture situation. By observing closely the slight changes in color of foliage, growers are often able to irrigate before it is too late. While some experience is required to detect these color developments it is frequently possible to prevent suffering of the plants by acting immediately upon the appearance of the darkened shade and duller aspect of the foliage.

Wilting and curling of the leaf edges is also an indication that large amounts of water are being transpired. The shorter the period of time during the day that this condition lasts the less serious it is.

Maintaining Adequate Moisture

As most of the vegetable crops have a comparatively shallow root system with a large proportion of the roots feeding in the upper strata of the soil, they are rather sensitive to fluctuations in moisture supply particularly if the soil becomes so dry as to check growth. The moisture content of the surface soil is particularly subject to variations following periods of intense heat, drying windstorms, long days of bright sunshine, and spells of low humidity, and the vegetable crops are often seriously injured in yields and quality by a shock due to deficient moisture.

Irregular supplies of moisture often produce second growth and growth cracks in potatoes, puffiness and blossoms end rot in tomatoes, monkey faces and splits in onions, and small sizes in other products, hence vegetables should not suffer from a lack of moisture at any time during the growing season.

Irrigation should be carefully regulated to suit the conditions which prevail at the time and place used for production of the crop. Growers are obliged to give careful attention to the factors which govern moisture conditions and water requirements. In order to regulate the frequency and amount of irrigation it is essential that frequent examinations of the soil in different portions of the field should be made to the depth of the root zone and that a constant and alert lookout be mantained for any indication that the plants need more water.

The soil and the plants also should be closely watched in order to determine the proper time for irrigation, and temperature, humidity, and wind velocity should be considered in connection with the irrigation schedule. Following periods of rapid evaporation and rapid transpiration it may become necessary to apply additional water or to speed up the irrigation under way. Promptness in supplying water at the right time is highly important. Delay may prove dangerous.

Irrigation Before Planting

After the land has been leveled and partially prepared, but early enough to permit weeds to start, to get land in the proper condition for final preparation, and planting operations scheduled at the proper time, the ground is commonly made ready for a preliminary irrigation or flooding. This wetting of the land before the seed beds are made is not absolutely necessary, but it has several important advantages:

(*Concluded on Page 97*)

San Diego Hails A.W.W.A.

(*Continued from Page 33*)

R. W. Keene, Hersey Manufacturing Co., Los Angeles.

L. M. Northrup, Neptune Meter Co., Los Angeles.

Louis L. Farrell, Supt. East Bay Water Co., Oakland.

George W. Trauger, Supt. Lindsay Strathmore Irrigation District, Lindsay.

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W. E. Metz, Chief Clerk, San Diego Water Department.

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Sergeant-at-Arms

J. F. Delaney, Supt. City Water Works, Los Banos.

Assistants

F. H. Fagg, Dist. Mgr. Pacific Gas and Electric Co., Stockton.

E. L. Longland, Supt. Municipal Water Works San Rafael.

J. R. Barker, Pacific Coast Mgr., Neptune Meter Co., San Francisco.

R. W. Keene, Hersey Manufacturing Company, Los Angeles.

Nominating Committee

George W. Pracy, Chairman, Supt. Spring Valley Water Co., San Francisco.

Judy I. Prugh, Supt. Division of Water, Sacramento.

L. M. Anderson, Comptroller, Department of Water and Power, Los Angeles.

Los Angeles' Meter Practice

(*Continued from Page 56*)

at the meter shop. The only work done in the shape of repairs to meters in the field is the renewing of registers that have been broken. Main casings of our velocity meters are left on the service. The cover containing gear train and register is removed and the cage containing propeller is taken out. These parts are then replaced with new ones and the old parts are brought to the shop for repairs. This eliminates a lot of hard and costly work. Our facilities for repairing and testing meters are very good. The shop contains concrete benches equipped with tanks for repairing and concrete benches for storing the meters ready for setting. The machinery consists of a lathe, pipe threading machine, wire wheels for cleaning the outside of meters and exhauster for carrying away the dust, grind stone and carborundum wheels, circular saw for cutting lumber for meter box forms, ball socket machining machine, gauges, press diaphragm cutter, etc. The machines are individually motor driven. Our force consists of a superintendent, who passes on meter parts, whether they are to be repaired or wholly replaced, and sees that every meter is properly repaired (not tinkered with). He also takes care of all repairs to service equipment.

Under him are two testers, a machinist (considered a meter repairer) and 12 meter repairers. Four clerks post maintenance cards, order, receive and account for all meter material received and make monthly reports of meter setting, etc., for Los Angeles, San Pedro and San Fernando Valley. On June 30, 1920, there were 218,635 meters in service, which at this date means one meter repairer for each 18,220 meters in service. The department takes out monthly about one meter for every 166 in service for not operating, due to all causes.

In the last twelve months 429 meters were taken out monthly for failure to operate, due to hot water or steam backing up from boilers or heaters. On the first occurrence of a meter being damaged by hot water or steam supplying a residence, a post card is mailed the

consumer, notifying him and requesting that care be taken to guard against a similar occurrence. On the second occurrence, a bill is rendered the consumer covering the cost of changing and repairing the meter. When meters are likewise damaged, supplying places of business, a bill is rendered on the first offense. The Department advises consumers to watch their heaters and not to use a check valve on their service, as it is cheaper to pay for repairing meter than to run the risk of bursting a boiler.

The organization of the Meter and Service Department consists of a general superintendent with four assistants.

The total force of the meter and service department at this date consists of 375 men, and they cover Los Angeles, San Pedro, San Fernando Valley and the West Gate district.

The city of Los Angeles was incorporated on April 4, 1850, and at that date its total area was 28 square miles. Today it covers an area of 429 square miles.

New service installations for all purposes for the last twelve months, covering all districts, have been at the rate of 1600 per month, and today show no signs of falling off.

On June 30, 1920, we had 240,567 services of all kinds and 218,635 meters.

$14,000,000 Asked for Land

The land owned by the Pacific Gas and Electric Company and by Stephen E. Kieffer and interests represented by him, involved in condemnation proceedings brought by the East Bay Municipal Utility District for use in connection with the proposed Lancha Plana dam and reservoir site, is valued by the defendants at $14,000,000. The land involved is required by the district and the original complaint asked the court to set a value upon it and to force its sale. The Lancha Plana dam and reservoir site is on the Mokelumne River, mostly in Amador County, California, but partly in Calaveras County.

Rice Industry Favored

To aid the rice industry in the vicinity of Merced, California, in growing and developing, directors of the Merced Irrigation District have decided to levy no special toll on rice lands for at least one year. Considerable agitation for a special tax rate on rice lands resulted in the district because of the greater irrigation necessary for rice crops.

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SURVEY *of* HYDRAULIC DEVELOPMENT

As Shown by Official Records of the Month -- Local, State, and Governmental

Applications Filed

Among the more important applications for permit to appropriate water filed with the State Department of Public Works, Division of Water Rights, California, during the month of September, 1926, were the following:

Application No. 5183 (Los Angeles County)—W. D. Rawson, c/o D. M. Baker, 1018 Central Bldg., Los Angeles, Calif., for .50 cubic feet per second and 40 acre feet per annum from Cold Creek and Unnamed Creek tributary to Malibu Creek to be diverted in Sec. 17, T 1 S, R 17 W, S. B. M. for domestic, irrigation and recreational purposes in Sec. 17, T 1 S, R 17 W, S. B. M. Estimated cost $10,000.

Application No. 5185 (San Diego County)—La Mesa, Lemon Grove and Spring Valley Irrigation Dist., 121 S. Spring St., La Mesa, Calif., for 50 cubic feet per second and 18,000 acre feet per annum from Santa Ysabel Creek tributary to San Dieguito River to be diverted in Sec. 19, T 12 S, R 3 E, S. B. M. for municipal purposes in towns of La Mesa, El Cajon, Lemon Grove and Spring Valley. Estimated cost $600,000.

Application No. 5187 (Alpine County)—F. C. Springmeyer, Gardnerville, Nev., for 150 acre feet per annum from Bull Lake tributary to E. Carson River via Wolf Creek to be diverted in Sec. 26, T 8 N, R 21 E, M. D. M. for irrigation purposes on 405 acres in Secs. 11, 14 and 15, T 12 N, R 20 E, M. D. M.

Application No. 5192 (Lassen County)—G. L. Kramer, Bieber, Calif., for 500 acre feet per annum from Widow Valley Creek tributary to Pit River to be diverted in Sec. 31, T 39 N, R 7 E, M. D. M. for irrigation purposes on 1000 acres in Secs. 30 and 31, T 39 N, R 7 E, and Secs. 4, 5, 6 and 9, T 38 N, R 7 E.

Application No. 5193 (Nevada County)—Nevada Irrigation District, Grass Valley, Calif., for 5000 acre feet per annum from Middle Yuba River tributary to Feather River to be diverted in Sec. 12, T 19 N, R 12 E, M. D. M. for irrigation purposes on 375,000 acres within said district.

Application No. 5199 (Modoc County)—Frank McArthur, Alturas, Calif., for 4 cubic feet per second and 9000 acre feet per annum from Crooks Canyon drainage area tributary to S. Fork Pit River to be diverted in Sec. 32, T 40 N, R 12 E, M. D. M. for irrigation and domestic purposes on 4680 acres near point of diversion. Estimated cost $75,000.

Application No. 5200 (Los Angeles County)—Arthur B. Caywood, Saugus, Calif., for .025 cubic feet per second from spring tributary to Mint Canyon to be diverted in Sec. 26, T 5 N, R 15 W, M. D. M. for irrigation and domestic purposes on 20 acres in Sec. 35.

Application No. 5201 (San Joaquin County)—Fred H. Finck, c/o Ohm & Raab, Stockton, Calif., for 3 cubic feet per second from Old River tributary to San Joaquin River to be diverted in Sec. 12, T 2 S, R 4 E, M. D. M., for irrigation purposes on 245.3 acres near point of diversion. Estimated cost $4,000.

Application No. 5202 (Ventura County)—Lewis C. and Wm. Plush, Stauffer, Calif., for 1 cubit foot per second from North Fork tributary to Lockwood Creek to be diverted in Sec. 24, T 8 N, R 22 W, S. B. M. for irrigation and domestic purposes on 160 acres in Sec. 29 and 32.

Application No. 5203 (Ventura County)—Glendora Consolidated Mutual Irri. Dist., Glendora, Calif., for 5200 acre feet per annum from Big Dalton and Little Dalton Canyon tributary to San Gabriel River to be diverted in Sec. 20 and 21, T 1 N, R 9 W, S. B. M. for irrigation and domestic purposes on 2461.95 acres.

Application No. 5204 (Butte County)—Mrs. Jennie La Point, Biggs, Calif., for 1 cubic foot per second from Lateral "A" Drainage Ditch of Dist. 833 tributary to Sacramento River to be diverted in Sec. 8, T 18 N, R 2 E, M. D. M. for irrigation purposes on 40 acres of rice in Sec. 8. Estimated cost $200.

Application No. 5207 (Sacramento County)—American River Hydro-Electric Co., c/o S. E. Kieffer, 57 Post St., San Francisco, Calif., for 600 cubic feet per second and 320,000 acre feet per annum from American River to be diverted in Sec. 24, T 10 N, R 7 E, M. D. M. for agricultural and domestic purposes on 150,000 acres adjacent to City of Sacramento between Lincoln and Elk Grove, Folsom and Roseville.

Application No. 5209 (San Joaquin County)—Theo. Lorenzen, et al, c/o Ohm & Raab, Stockton, Calif., for 12.62 cubic feet per second from San Joaquin River tributary to Suisun Bay to be diverted in Sec. 16, T 2 S, R 6 E, M. D. M. for irrigation purposes on 1010.2 acres in Secs. 15, 16, 17, 20, 21 and 29. Estimated cost $12,000.

Application No. 5210 (Solano County)—L. A. Sackett, Winters, Calif., for .75 cubic feet per second from Putah Creek tributary to Sacramento River to be diverted in Sec. 26, T 8 N, R 2 W, M. D. M. for agricultural purposes on 60 acres of land in Sec. 26. Estimated cost $2000.

Application No. 5212 (Butte County)—Willis M. Spesert, Chico, Calif., for 1 cubic foot per second from Rock Creek tributary to Sacramento River to be diverted in Sec. 23, T 23 N, R 1 E, M. D. M. for irrigation and stock purposes on 55 acres in Sec. 23. Estimated cost $250.

Application No. 5215 (Santa Cruz County)—City of Santa Cruz, Santa Cruz, Calif., for 25 cubic feet per second from San Lorenzo River tributary to Pacific ocean to be diverted in Sec. 12, T 11 S, R 2 W, for municipal purposes to supply City of Santa Cruz and adjoining area.

Application No. 5217 (Sonoma County)—G. D. Smith, Rio Nido, Calif., for 1.5 cubic feet per second from 2 unnamed streams tributary to Russian River to be diverted in Sec. 26, T 8 N, R 10 W, for irrigation purposes on 45 acres in Sec. 26. Estimated cost $10,000.

Application No. 5219 (San Mateo County)—Cuesta-La Honda Co., 212 Sutter St., San Francisco, Calif., for 0.25 cubic foot per second from Mindego Creek tributary to Alpine and San Gabriel Creeks to be diverted in Sec. 13, T 7 S, R 4 W, M. D. M. for domestic, lawn and garden purposes on 100 acres. Estimated cost $10,000.

Application No. 5222 (Sutter County)—Judah Boas Finance Corporation, 454 Montgomery St., San Francisco, Calif., for 40.00 cubic feet per second from Sacramento River tributary to Suisun Bay to be diverted in Sec. 23, T 13 N, R 2 E, M. D. M., for agricultural purposes for the irrigation of 1600 acres of rice. Estimated cost: Already completed.

Permits Issued

Among the more important permits to appropriate water issued by the Department of Public Works Division of Water Rights, California, during the month of September, 1926, were the following:

Permit No. 2609, Application No. 5100 (Sutter County) Issued to Steve M. Burtis, Meridian, Calif., September 7, 1926 for .83 cubic feet per second from Sacramento River in Sec. 24, T. 15 N, R 1 W, for irrigation of 66.41 acres in Sec. 24. Estimated cost $500.

Permit No. 2610, Application No. 5047 (San Joaquin County) Issued to Mrs. Louisa Stark, Stockton, Calif., Sept. 8, 1926, for 16.66 cubic feet per second from Salmon Slough and Middle River in Secs. 23, 35, 27, T. 1 S, R 5 E, for irrigation of 1334.8 acres near points of diversion. Estimated cost $10,000.

Permit No. 2615, Application No. 4898 (Butte County) Issued to Henry D. & Edward Gage, Chico, Calif., Sept. 13, 1926, for 8 cubic feet per second from Cherokee Slough in Secsfl 22 and 11, T 19 N, R 2 E, for irrigation of 720 acres near point of diversion.

Permit No. 2618, Application No. 5099 (San Bernardino County) Issued to U. S. Forest Service, San Bernardino, Calif., Sept. 20, 1926, for .35 cubic feet per second from 4 unnamed springs in Secs. 24, 25, 26, 36, T 2 N, R 2 W, for domestic purposes on 214 lots. Estimated cost $10,000.

Permit No. 2619, Application No. 5014 (Santa Barbara County) Issued to F. W. Matthiessen, Triunfo, Calif., Sept. 21, 1926, for 1.25 cubic feet per second from Hot Springs Creek in Sec. 11, T 5 N, R 29 W, for domestic and irrigation of 230 acres near point of diversion.

Permit No. 2623, Application No. 5015 (Plumas County) Issued to F. F. Ford (Trustee-for Lott's Lake Ass'n) c/o R. M. Gray, Oroville, Calif., Sept. 23, 1926, for .002 cubic feet per second from unnamed spring in Sec. 15, T. 25 N, R 5 E, for do-

mestic purposes in Sec. 15. Estimated cost $500.

Permit No. 2626, Application No. 4883 (San Bernardino County) Issued to Fisher C. Bailey, Beverly Hills, Calif., Sept. 24, 1926, for .10 cubic feet per second from spring and unnamed creek in Sec. 17, T 2 N, R 1 W, for domestic and irrigation of 10 acres near point of diversion. Estimated cost $4000.

Permit No. 2627, Application No. 4884 (San Bernardino County) Issued to Fisher C. Bailey, Beverly Hills, Calif., Sept. 24, 1926, for .15 cubic feet per second from 2 unnamed streams in Sec. 17, T 2 N, R 1 W, for domestic and irrigation of 12 acres near point of diversion. Estimated cost $4000.

Permit No. 2629, Application No. 5003 (Siskiyou County) Issued to Morgan A. Gunst, 601 3rd St., San Francisco, Calif., Sept. 27, 1926, for 808 gallons per day from unnamed spring in Sec. 24, T 47 N, R 6 W, for domestic and irrigation of 10 acres in Sec. 25. Estimated cost $1000.

Permit No. 2630, Application No. 4681 (Yuba and Nevada Counties) Issued to Dry Creek Irrigation Dist., Wheatland, Calif., Sept. 28, 1926, for 13,798 acre feet per annum from Dry Creek in Secs. 32 and 35, T 15 N, R 6 E, for irrigation of 4000 acres and stock watering within said district. Estimated cost $300,000.

Permit No. 2631, Application No. 2270 (El Dorado County) Issued to El Dorado Irrigation Dist., Placerville, Calif., Sept. 30, 1926, for 150 cubic feet per second and 29,000 and 7000 acre feet from N. Fork Cosumnes River, Camp Creek and Sly Park Creek in Secs. 4 and 10, T 9 N, R 14 E, Secs. 24 and 9, T 10 N, R 13 E, and Sec. 25 T 10 N, R 14 E, for irrigation of 30,702 acres within El Dorado Irrigation Dist. Estimated cost $1,030,000.

OREGON

Among the more important applications for permit to appropriate water filed in the office of Rhea Luper State Engineer of Oregon, Sept. 4 to Oct. 9, 1926, inclusive, were the following:

S. N. Belton of Burns, covering the appropriation of underground water for irrigation of 232.26 acres in Harney County, at a cost of $4500.00.

Arthur C. Keene of Heppner, covering the appropriation of water from Rhea Creek for irrigation of 32 acres in Morrow County.

J. I. Hall of Myrtle Creek, covering the appropriation of water from Myrtle Creek for irrigation of 15 acres in Douglas County.

C. E. Hoyt of Fort Klamath, covering the appropriation of water from Wood River for irrigation of 8 acres in Klamath County.

Arnold Irrigation Company of Bend, covering the construction of the Arnold Crane Prairie Reservoir for storage of 120,000 acre feet of water from West Fork Deschutes River and tributaries for irrigation, power and domestic purposes in Deschutes County. at a cost of $200,000.

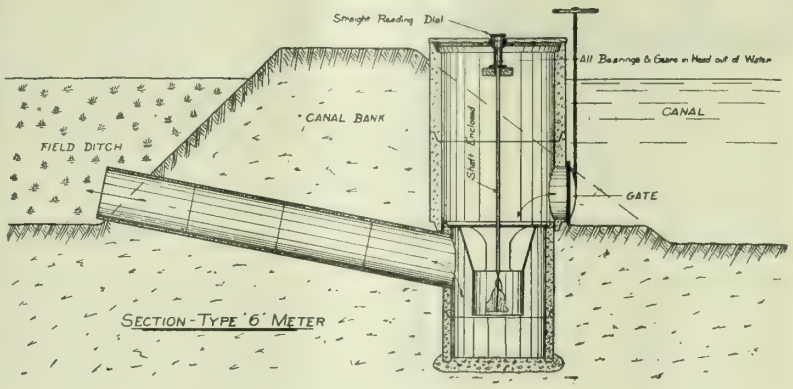
Carl Ober of Tygh Valley, covering the appropriation of water from White River for irrigation of 20 acres in Wasco County.

Laura Elliott of Elgin, covering an appropriation of water from Clark's Creek, for irrigation of 40 acres, at an estimated cost of $100.

Nick Barry of Adel, Lake Co., covering an appropriation of water from Jack Creek tributary to Guano Lake for storage for irrigation at an estimated cost of some thousands of dollars.

Albert S. Brown of Grants Pass, covering an appropriation of water from springs on

The RELIANCE METER



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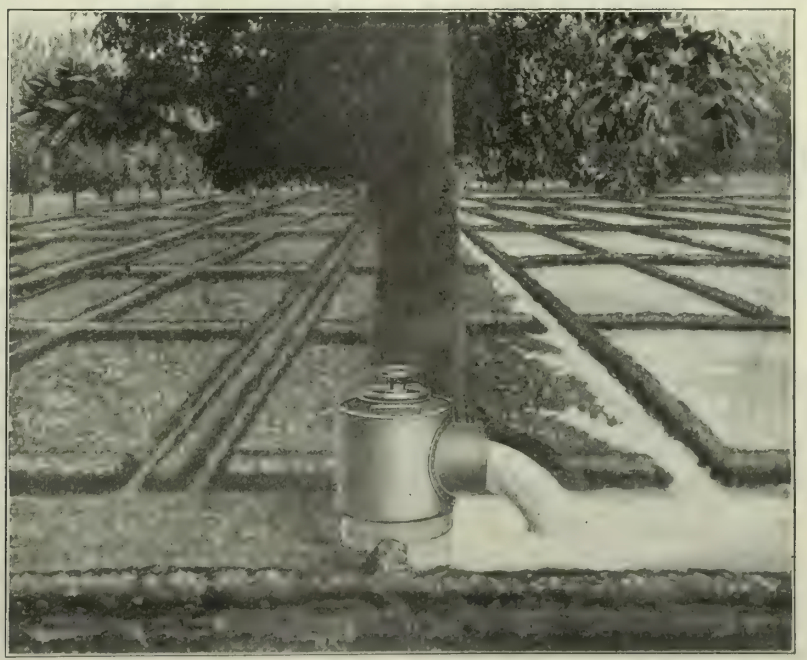

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Sexten Mountain for irrigation of 10 acres, at an estimated cost of $200.

B. M. Porden of Portland, covering an appropriation of water from Poison Slough in Marney County for irrifiation of 100 acres.

Louis Keil of Aurora, covering an appropriation of water from unnamed tributary of Willamette River in Clackamas County, for domestic use and irrigation of 2 acres, at an estimated cost of $500.

Louis Miller and Geo. A. Grieve of Hornbrook, covering an appropriation of water from Jenny Creek in Jackson Co. for irrigation of 57 acres, at an estimated cost of $1000.

"Winning of the West" League Answer to Hoover's Plea

(*Continued from Page 18*)

der Dam project as recommended by the committee of engineers, and said that the sale of water and power wholesale to municipalities and large organizations would pay off the entire project in 25 years.

The Boulder Dam project was opposed by State Senator Fred T. Colter, president of the Arizona High-Line Reclamation Association, who urged as a substitute the construction of dams across Glen and Bridge Canyons, and a high-line canal, diverting water by gravity to irrigate 3,500,000 acres of land in Arizona and to develop power that would more than pay for the whole project.

State Senator Charles P. Squires, of Las Vegas, Nevada, who had taken part in more official conferences on the Colorado River than any other delegate present, declared that an agreement could be reached that would be fair to Arizona, California and Nevada. He said that the problem should be approached in a statesman-like manner and not with petty interests dominating.

New Mexico's View

Dr. H. L. Kent, president of the New Mexico Agricultural College, spoke of the problems of New Mexico and western Texas. He described the Rio Grande and spoke of the necessity for water storage along the Pecos River.

The situation in the Sacramento-San Joaquin Valleys was forcefully presented by Ben M. Maddox, of Visalia, member of the California State Irrigation Association. He stated that they had water enough to irrigate eighteen million acres if it were conserved, and said that the greatest problem was to get the facts before the people. "The state has spent $250,000 to get a report on our water resources," he said, "and how many of you have ever even read this report?"

The necessity for preserving the forests was brought out by Congressman A. M. Free, of San Jose, California. The water originates in the forest water sheds, he explained. As the forests are allowed to burn, the floods become more disastrous and the ensuing scarcity of water more acute. In 1924, according to Mr. Free, there were 162 forest fires in Southern California, burning 154,000 acres of government land and 20,000 acres of private land. It cost the government $375,000 to put out these fires, as against $9,000 that had been appropriated for fire prevention.

Committee Formed

Organization of the "Winning the West" League was through a resolution introduced by Arthur E. Miot, secretary of the Tulare County Board of Trade, declaring approval of the principles set forth by Hoover, and calling for the appointment of a committee to confer with him regarding the procedure to be followed. Thomas E. Campbell, as chairman of this committee, appointed the following members as co-workers:

John L. Bacon, mayor of San Diego and president of the Bouder Dam Association; Shirley C. Ward, member of the power and reclamation committee of the Los Angeles Chamber of Commerce; Hervey Lindley, of Seattle, president of the Columbia Basin League; I. E. Vining, of Portland, president of the Oregon State Chamber of Commerce; Fred Farrar, Chamber of Commerce, Denver; Charles P. Squires, Las Vegas, Nevada; Dr. H. L. Kent, president of the New Mexico Agricultural College; W. F. Jensen, Salt Lake City, personal representative of Governor Dern, of Utah.

Secretary Hoover is expected to arrive in Los Angeles on October 30, and the committee, representing the "Winning of the West" League, will then discuss with him the first steps to be taken in making the league an active force in the development of water resources throughout the country.

Legal and Judicial News

(*Continued from Page 88*)

ling element, the character of the tax, is the same in each case; hence the rule is the same."

This case once again brings up the question as to whether irrigation district assessments are general or special liens. Outside of Colorado it would appear that the generally accepted theory was that such assessments are general liens.

Water Right and Right of Service Distinguished

Under Washington Statutes a water right does not come under the control of the Public Service Commission.

In the case of Ament vs. Bickford 247 Pac. Rep. 952 (July 14th, 1926) the predecessor in title of respondent, in 1912, sold to the predecessor in title of the appellant, a parcel of land. Coincidently and according to the contract of sale, "as a part of the consideration of said purchase price and as a contract run-

ning with the land" the respondent conveyed a perpetual right to . . . water . . . and appellant agreed to pay annually a definite amount for the use of the water system from which the water originated. After many years of observance of the contract . . . the respondent interfered with the appellant's rights and destroyed the water connections and shut off the supply.

A demurrer to the complaint was sustained by the trial court.

Among the points made by respondent in support of the Trial Court's Order was that the contract was void and unenforceable for the reason that the water owned by the grantor was subject to regulation by the Public Service Commission. On this point the Supreme Court of Washington states:

"No merit is found in this claim, for the purchase was not of water from a water system, but of a certain definite water right. If the respondent's theory was correct, every owner of a water right in the State might be subject to regulation by the Public Service Commission."

Irrigating Vegetable Crops

(*Continued from Page 92*)

(1) Weed seeds germinate in large quantities and weeds are killed in wholesale fashion prior to planting, thus reducing the amount of hand labor and damage from volunteer growth during the growing season.

(2) Organic matter is decomposed more rapidly and with less loss of nitrogen.

(3) Action of beneficial bacteria is started earlier.

(4) Beds hold up better if made of moist soil.

(5) The first furrow irrigations are more rapid and thus less expensive.

(6) If the irrigation shows irregularities in the land it is sometimes still possible to correct them before planting time.

Not An Essential Practice

In spite of the fact, however, that there are some decided advantages in this preliminary irrigation it has been demonstrated repeatedly that it is not strictly necessary. Unless this irrigation can be given early enough to permit final preparations for planting at the proper time it should be omitted.

In preparing for flooding, the land is floated and borders are thrown up to make checks. These borders may be made with plows, bordering disks, or special bordering tools, one of which is built with planks standing on edge and converging at the rear.

In some cases seed beds are made in land which has not received a preliminary flooding and the beds are wet before planting by running water in the furrows. The water is allowed to sub thoroughly through the beds so that it finally moistens the entire beds.

Irrigation When Planting

In arid or semi-arid localities such as Imperial, Salt River, Snake River, and even San Joaquin valleys, it is the customary practice with some crops at least to irrigate in furrows as soon after planting as it is desired to bring up the crop. The beds are irrigated continuously until germination takes place and the small plants appear above ground. In some instances this irrigation follows planting immediately but this is not always the case.

If the stand of plants is not satisfactory some times another irrigation is given to germinate more seed. In some cases an irrigation after thinning is desirable as it supplies abundant moisture at this critical time.

Crops which are commonly transplanted, such as cauliflower, cabbage, tomatoes, celery, etc., are usually irrigated immediately after being set in the field. As soon as possible each row is irrigated by turning water down the furrow.

Encourage Deep Root System

As a rule, however, irrigation during the early stages of growth should be practiced with caution. A deep root system should be encouraged and this will not form when there is an abundance of moisture near the surface. Moreover the young plants with a very limited leaf surface do not require large amounts of moisture particularly during the cooler portions of the year. With cantaloupes, tomatoes, and potatoes, especially, a deep root system is recognized as highly desirable and sometimes several weeks are allowed to pass without irrigating in order to assure deep penetration of the roots.

Yet in endeavoring to promote a good root system one should not go to extremes. A sturdy deep-rooted plant is undoubtedly better than one which is sappy, tender, and supported largely by surface feeders, yet caution should be exercised by the grower in order to avoid injury which might occur under certain conditions. If there is any doubt in the grower's mind as to the moisture content of the sub-surface soil, he should investigate in different portions of the field to determine to his own satisfaction that ample moisture is available. With potatoes there should be a very favorable moisture situation at setting time if a liberal set per hill is desired.

Sometimes it is advisable to irrigate in advance of the time the plants appear to actually need more water. This is true when water cannot always be had at the desired time, or where the fields are so large that it is impossible to get over them soon enough if the start is deferred until the last minute.

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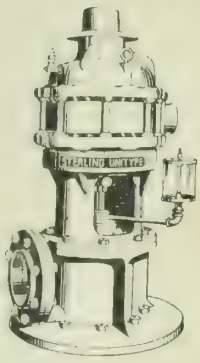

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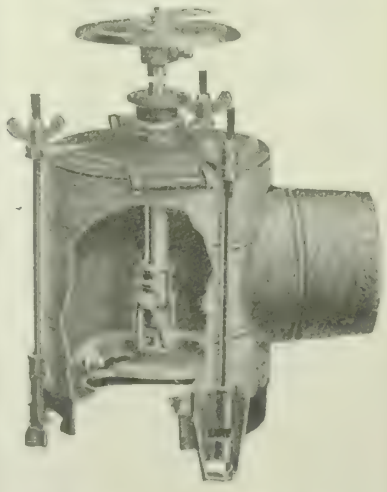

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AMONG OUR CONTRIBUTORS

Editorial Jottings About Current and Forthcoming Feature Articles; Dealing With Practical Problems of Hydraulics, and the Men Who Have Written Them

HARLOWE M. STAFFORD, water supervisor for the Sacramento and San Joaquin Rivers, and associate hydraulic engineer of the California Division of Water Rights, is the author of the informing article which presents the highlights of the dramatic situation in which water users of these rivers are being forced into the most rigid forms of conservation in order to keep a flow ever going into the sea.

Mr. Stafford was educated in California schools and received his B. S. degree in engineering from the University of California. His early experience was with the U. S. Geological Survey, followed by service with the Anderson-Cottonwood Irrigation District, as office engineer; and a term of service in charge of rice irrigation experiments for the U. S. Department of Agriculture.

In 1918 he became office engineer and resident engineer on construction for the Happy Valley Irrigation District, and in 1920 was called to similar duties for the Corcoran Irrigation District. The following year he became identified with the state Division of Water Rights, with which he has been connected in various capacities, first in field investigations, inspections and reports, and since 1924 in the important position which he now holds.

CHARLES H. LEE, writer of the comprehensive "Water Survey of San Francisco District," is a consulting engineer in private practice in San Francisco, specializing in water supply and development.

Mr. Lee graduated from the College of Civil Engineering, University of California, in 1905. From 1906 to 1912 he was associated with William Mulholland in the work on the Los Angeles aqueduct. During 1912 he was assistant engineer of the State Conservation Commission of California, investigating underground water conditions and water spreading in Southern California. He then engaged in private practice in Los Angeles, giving special attention to hydro-electric power, irrigation, and public water supply.

With the entrance of the United States in the World War, Mr. Lee went with the American Expeditionary Forces to France, where he served as first lieutenant and captain, planning and installing water developments along the lines of communication and on the active

Harlowe M. Stafford

front. On his return to California in 1919 he became an executive member and president of the California State Water Commission, and later chief of Division of Water Rights, State Department of Public Works. Since 1922 Mr. Lee has been engaged in private practice.

FRED A. RHODES, who prepared the illuminating discussion of the water situation in San Diego and the city's plans for the future, is city manager of San Diego. Mr. Rhodes has been the main factor in working out the plans for water development and in securing their adoption, and has just directed the water bond election for an issue of $2,000,000 that went over twelve to one.

R. G. RISSER, who writes on "Keeping out of the Red with Vegetables," has been for the past seven years manager of the crop production department of the California Vegetable Union. Before entering upon his present work, Mr. Risser was for several years connected with the United States Department of Agriculture, as a specialist in irrigated vegetable crops. He is the author of a number of articles on various phases of vegetable growing.

ADOLF H. KOEBIG, JR., who contributes the feature article for the Sewage Disposal department of WESTERN WATERWORKS, has had a wide contact with the irrigation and allied hydraulic industries. His technical training was received at Stanford University and Amherst College, where he majored in civil engineering, after which he was connected with the good roads department of Los Angeles County, California. Later he went with the Los Angeles County construction department as supervising engineer of re-enforced concrete buildings.

Following a varied experience in the building trades, Mr. Koebig then became associated with his father, Adolf H. Koebig, of Koebig and Koebig, Los Angeles, one of the pioneer engineers of the west, who has figured prominently in the designing and construction of many of the major hydraulic projects of California and other western states. With Koebig and Koebig (as the firm later became known), his first work consisted of field investigations. In a short time he became supervising engineer on several important irrigation, drainage, sewerage, and hydro-electric projects, and was made junior partner.

While Mr. Koebig's work has been in various engineering fields, he is regarded as an authority on sewerage construction. The new sewage disposal system at El Segundo, as described in this issue of WESTERN WATERWORKS, has attracted wide interest among municipal and sanitation engineers and we feel fortunate in being able to secure the first publication of an article upon this most interesting installation.

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Published Monthly by Petroleum World Publishing Company, Inc.; Copyright, 1926; All Rights Reserved
For 12 Months: $2.00; Single Copies: 20 cents.

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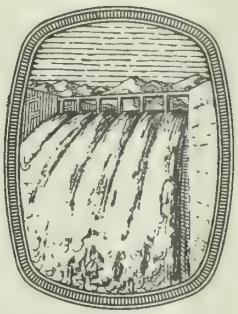
"Western Waterworks" Begins on Page 25

S. B. MORRIS

Who was elected chairman of the California Section of the American Water Works Association at the Section's seventh annual convention in San Diego in October. Mr. Morris has long been prominent in the councils of the California Section, having served successively as secretary-treasurer and vice chairman prior to his recent election to the chairmanship.

MODERN Irrigation
The Magazine of Applied Hydraulics



Volume II NOVEMBER, 1926 Number 11

The Progress of Irrigation

WITH the close of the year only a little more than a month away it seems fitting to review agricultural conditions on the irrigation projects of the Bureau of Reclamation. Crop information on these projects is in such form that it is possible to collate it and thereby obtain a panorama of the irrigated crop situation generally. Conditions at the close of October on the various projects were as follows:

Yuma project, Ariz.-Calif.—Planting of 2,500 acres of lettuce was nearly completed and the crop was coming up very satisfactorily. The new crop of alfalfa hay was very good and the market had improved $3 to $4 a ton. Cotton picking continued and excellent yields were anticipated. About 16,000 bales had been ginned at the end of the month, compared with 13,600 bales at the same date last year. The citrus fruit crop on the Mesa will amount to about 4,000 boxes. During the month 341 carloads of agricultural products valued at $490,600 were shipped from the project, making a total since the first of the year of 2,669 carloads valued at $2,630,000.

Orland project, Calif.—Most of the cotton had been picked during the month, with a yield about the same as last year. The price, however, was so low as to make the crop unprofitable. The fifth crop of alfalfa was cut. Olive picking was in progress. Preparations were being made by the Orland Orange Growers' Association to begin packing the crop during November.

Grand Valley project, Colo.—Alfalfa produced a good yield of excellent quality, but the market was limited and prices were low. The tomato harvest extended longer than normal and excellent yields were promised. Good crops of apples and pears were grown, but prices were unsatisfactory. Poor yields were reported for potatoes, beans, and sugar beets.

Uncompahgre project, Colo.—Reduced yields were reported for the principal money crops, namely, potatoes, onions, and beets. The price of potatoes ranged around $1.90 per hundredweight, but much of the crop was being stored for higher prices. Most of the onion crop was also going into storage.

Boise project, Idaho—Picking and packing of fruit were completed during the month, and threshing was practically finished. Hay was selling from $7 to $8 a ton with little demand.

Minidoka project, Idaho—The yield of

"Western Waterworks" Begins on Page 25

potatoes was better than expected and prices advanced from $1.50 to $2 per hundredweight at the end of the month. Harvesting of this crop was completed and 552 carloads were shipped from project towns. A large portion of the crop was stored. Clover seed yielded well and commanded good prices.

Huntley project, Mont.—Harvesting of the beet crop was completed during the month and yields were invariably excellent. Several growers reported total yields of more than 1,000 tons each.

Milk River project, Mont.—Harvesting of all crops was practically completed. The sugar beet yield was very satisfactory. On the Malta division several fields yielded more than 15 tons per acre. On the Chinook division the maximum reported yield was 26 tons per acre. A considerable increase in the acreage of this crop is expected next season. Two carloads of certified seed potatoes were shipped to southern markets and about 12 more carloads will be forwarded later. The average yield of this crop was reported to be about 350 bushels per acre.

Initial furrow irrigation of celery immediately following transplanting in Southern California

Sun River project, Mont.—Threshing of small grain was completed. Sugar beets will yield about 12 tons per acre. Good yields of potatoes were obtained and satisfactory prices prevailed. Considerable fall plowing had been done. As a result of favorable crop conditions and prices there was a much better feeling among the farmers on both divisions.

Lower Yellowstone project, Mont.-N. Dak.—All crops had been harvested and good yields were reported. A water user at Fairview produced $800 worth of cabbages on 1¼ acres, or at the rate of $600 an acre.

North Platte project, Nebr.-Wyo.—The potato harvest was completed and about 85 per cent of the beets were out of the ground. The reduced yield of potatoes owing to frost was offset by the favorable price. The yield of sugar beets will be about 25 per cent less than the record crop of 1925.

Newlands project, Nev.—There will probably be no surplus alfalfa this year as large shipments of feeder cattle are coming to the project from Idaho. Contracts for sugar beet acreage were being signed and the Fallon Sugar Company states that the factory will operate in 1927.

Carlsbad project, N. Mex.—At the close of the month 5,500 bales of cotton had been ginned. The prevailing price of good grade cotton was around 13 cents at the end of the month.

Rio Grande project, N. Mex.-Tex.—Cotton ginning was considerably delayed by wet weather. The price ranged around 14 cents a pound. Alfalfa was selling for about $15 a ton.

Klamath project, Ore.-Calif.—Harvesting of crops had been completed with the exception of potatoes, of which about 75 per cent had been dug. Excellent yields of this crop were reported and about 200 carloads had been shipped.

Belle Fourche project, S. Dak.—Harvesting of sugar beets continued and about 85 per cent of the crop had been delivered at the dumps. About 400 carloads had been shipped from the dumps and about 225 cars remained in huge piles at Nisland and Fruitdale. The yield will average 14 tons per acre with some growers reporting 18 to 20 tons. Picking corn was in progress. About half the crop was being harvested by sheep and hogs. Yields were excellent.

Yakima project, Wash.—In spite of the heavy drop of apples following the frost late in September, the crop appeared to be the largest in the history of the project. The entire crop had been harvested and warehouses were packed to capacity. Owing to low prices, however, the profit to the growers will be small. Shipments of apples exceeded those of October 30 of last year by 2,359 cars. The total fruit shipments from the valley amounted to 12,691 cars and vegetables to 4,175 cars. This is 1,122 cars in excess of the number shipped up to the same date last year. The potato crop was reduced about 20 per cent, but the demand was heavy.

"Western Waterworks" Begins on Page 25

This is Lake Henshaw, from which the Vista Irrigation District draws the water to supply 14,600 acres of land, the allocation of which, within the district, called forth an unusual and ingenious legal expedient, described in the accompanying article.

How the Vista Irrigation District Solves Its Complex Riddle of Water Allocation

By GEORGE S. HENRY

Presient, Vista Irrigation District, California

ALLOCATION OF WATER in an irrigation district which embraces lands of varying character and water requirements is one of the most perplexing practical problems facing the district manager. The particular section of the statutes governing the matter is closely correlated with that of land valuation for assessment purposes, which gives rise to much confusion in attempting to reconcile theory with practice. This problem of water allocation was met in an ingenious manner by the Vista Irrigation District of San Diego County, California.

The water supply for the Vista district is obtained from Lake Henshaw on the upper San Luis Rey River under a perpetual purchase contract with the San Diego County Water Company. The amount is definitely fixed at 13,600 acre feet* per annum at the end of ten years, through annual increments of 10 per cent during the interval, designed to permit of progressive development and colonization of the lands without excessive burden of charges for water service meanwhile.

The territory embraced within the district aggregates 17,600 acres and is generally rolling, of varying soil types and character, with some broken untillable land. No classification of the lands was made when the boundaries of the district were fixed, but it was assumed that 60 per cent would be irrigable and tillable.

Before sanction of a bond issue could be secured from the Bond Certificate Commission which has jurisdiction in California, the then State Engineer, W. S. McClure, ruled that, as a prerequisite, the water supply should be definitely limited to a duty of one acre foot per gross acre of land. In other words, the 13,600 acre feet of water then contracted for should be allocated to no more than 13,600 *gross* acres of land.

Since statistics have shown that from 15 per cent to 25 per cent of any irrigation project fails to use water from year to year, this requirement was intended to give an available average of from 1.15 to 1.25 acre feet per net irrigated acre. This duty of water in the district may appear high, but conditions are extremely favorable at Vista and experience is proving it conservative. To comply with the state engineer's requirement necessitated either disorganizing the district and reorganizing to embrace an acreage corresponding to the formula for water supply, or the exclusion of about 4000 acres. The latter alternative could be accomplished only through consent of the owners, since there is no power in the board of directors to force such withdrawal.

But either of these two methods presented insurmountable obstacles, and finally a novel and hitherto untried solution was evolved. The statute permits an owner of land in an irrigation district to *assign his right* to the use of the water allocated to his property to others within the district. Taking advantage of the provision, Senator Leroy A. Wright, attorney for the district, formulated an assignment or waiver whereby, for a mutual consideration, the land owner assigned to the district *in perpetuity his right to demand water* for a

*Since the original contract was made, the district has acquired from the water company 1,000 acre feet per annum on a straight delivery basis.

"Western Waterworks" Begins on Page 25

specified and legally described portion of his land. This procedure was given close scrutiny by the ablest irrigation attorneys in the state and was favorably endorsed.

Putting It Into Effect

Promptly thereafter the board of directors appointed a land classification committee, composed of men of experience and standing in the locality, aided by several outsiders, and a careful classification of the lands of the entire district was made, and such areas as, in the judgment of this committee, because of character of soil or topography or being otherwise unworthy of irrigation, were "declassed." Where possible, as was the case generally, the land owner accompanied the committee and his assent to the "declassification" was obtained on the ground.

An engineering crew then traversed the areas so "declassed" and prepared legal descriptions, using government subdivisions as far as possible by slight shifting of meander courses; otherwise by straight metes and bounds. These descriptions were then incorporated in the assignment or "waiver," duly executed and acknowledged before a notary by the owner and held for recording at the proper time.

It so developed that the aggregate area covered by these assignments, plus a few exclusions of lands on the exterior boundaries of the district, effected a reduction of irrigable acreage to an exact agreement with the water supply requirements. These assignments were then placed on record. Certificates of title covering land within the Vista district now make note of the fact of the assignment or waiver of *right to demand* water on these specified areas, which is notice to subsequent purchasers of the status of such lands. These areas are generally termed "waived lands" throughout the district, and while at first some confusion existed as to their status, that has rapidly cleared up and their utility is being realized as will further appear.

The district subsequently procured an additional 1,000 acre-feet of water and released the assignments or waivers on one thousand acres of "waived lands," so that the present water supply is 14,600 acre-feet. The result of the foregoing procedure is that the water supply of 14,600 acres is definitely allocated to 14,600 acres of land having so-called "full water rights."

"Toll and Assessment" Plan

The district has adopted a combined "toll and assessment" plan to meet its budget, which is particularly practicable and feasible because of the purchase of its water on a metered basis for a predetermined amount. A budget is prepared to cover solely estimated maintenance and operation costs, and accruing bond interest for the ensuing fiscal year. The assessor fixes the valuation of the lands within the district on a carefully zoned and balanced scale of values ranging from $135 minimum to about $300 per acre on irrigable land with "full water rights," except for town lot sub-divisions which aggregate somewhat higher on acreage basis.

The "waived" lands are valued at from $1.50 to $5.00 per acre, the intention being to eliminate as nearly as possible all tax burden on lands so divested

(*Continued on Page 36*)

ABOVE: Map of a portion of San Diego County, showing the outlines of the Vista Irrigation District. This district does not show the "Swiss cheese" silhouette to be noted in many districts that have faced a similar problem of water allocation. The advantages of leaving within the district, both legally and geographically, the lands that have waived water rights, are told in this article. The relation of the Vista district to other recent hydraulic developments in San Diego County appears on the map. BELOW: Chief Engineer Kenneth Q. Volk looks over the district from the main conduit, a gunite flume, constituting a remarkable piece of irrigation construction.

"Western Waterworks" Begins on Page 25

Washington State College, Pullman, Washington, an institution that has played an important part in the development of irrigation in the Northwest.

"The Farmer Can Not Afford to Experiment—The College Must Do It for Him"

Says O. L. WALLER

In Describing the Services that Washington State College Has Rendered to Irrigation—Another of MODERN IRRIGATION Articles Devoted to the Function of the Colleges in Hydraulic Progress

IN 1900, the State College of Washington co-operated with the United States Department of Agriculture under the direction of Dr. Elwood Mead, then Chief of Irrigation Investigations for the United States Department of Agriculture, in making a study of the duty of water in the Yakima Valley. This early work consisted in trying to find out how much water the farmers were accustomed to use for growing crops. One season was devoted to determining the co-efficient of friction in irrigation canals. At that time the college had no definite experiment station and made the duty of water studies in co-operation with farmers who were willing to apply the water on certain plants as directed, and on others as they were accustomed to apply it. Some very good results were secured, particularly in connection with the irrigation of potatoes. One set of tests showed that about eighteen inches of irrigation water per acre gave the highest starch content in potatoes, and the highest yield of marketable potatoes.

While no direct experimenting was carried on for a number of years after this, much help was offered to the farmers in the irrigation districts by the faculty of the college, both in engineering and in agriculture. In 1909, the writer prepared a bulletin for the U. S. Department of Agriculture on "Irrigation in the State of Washington." The bulletin was written to supply a demand for information concerning irrigated agriculture in Washington.

Conflict in Doctrines

The water-right laws of Washington were built upon the English doctrine of riparian rights, supplemented by a statute providing that water might be appropriated. These two doctrines were in direct conflict, and were the source of much trouble in the irrigated districts. The streams of the state had been very much over-appropriated and water-right conflicts were frequent. There was no way by which one could know how much water his land was entitled to, and he did not know how much he would be protected in the use of. It was apparent that all water-rights in the state should be determined and titles set at rest so that an abstract of title would cover water rights as well as the land upon which it was used. In 1904, Governor Henry McBride appointed an irrigation commission to draft a water code for the state. This commission reported to the following legislature but their recommendations failed to become law. On this commission Washington State College was represented in the person of its president, E. A. Bryan.

Shortly after the National Irrigation Congress met in Spokane in 1909, Governor M. E. Hay appointed a commission to draft a water code for the state. The writer was chairman of this commission. A water code, closely following that of Wyoming and Oregon, was drafted, was printed and went to the legislature for consideration but failed to become a law.

Third Commission Tries

Governor Ernest Lister appointed a third commission consisting of seventeen members, to try to draft a water code that would be satisfactory to the state legislature. Again the chairmanship was given to the State College. This bill was printed and presented to two sessions of the legislature and finally, in 1917, was adopted. Under the provisions of this bill, water rights may be adjudicated by the Supervisor of Hydraulics, subject to appeal to the courts.

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The plan is very effective and titles are secured at a minimum of cost. The enactment of this law has meant very much to the state since it is now possible for anyone using water for irrigation or power to have his rights completely defined and set apart for a particular use.

Branch Authorized

In 1917, the legislature authorized the establishment of an irrigation branch station for the purpose of studying the principles and practices of irrigation agriculture. A committee of five men, experienced in irrigation and agriculture, were detailed to make a selection of land for an experiment station. A number of sites were examined, and one at Prosser, Washington, was finally selected. This station covers a variety of soils from light sandy soil to a silt loam. Upon it can be found almost any type of soil that is now used for irrigation purposes anywhere in the state. A location having on it such a variety of soils makes it possible to carry on experiments fitting the various types of irrigated lands in the State.

Irrigation is an artificial way of supplying moisture to growing crops. The amount of water to be used and the time when it is to be applied are under the control of the farmer. He, therefore, needs information concerning the water holding capacity of the soil so that he may know how much water to apply at an irrigation, to the end that there may be a minimum of leaching into the sub-soil and that waste of water and fertilizer may be avoided. The farmer wants to know what crops are best adapted to his climate and soil. He also wants to know when to irrigate and how much water to apply at an irrigation.

Water a Measured Service?

Sometime, not far in the future, water will be sold by quantity as other commodities are sold and then the irrigator will want to get the maximum return for the money spent for an acre-foot of water. It is the purpose of the irrigation station to show how this may be done. To get the best return from the irrigated farm, the farmer must plant the right kind of crops and the right varieties; he should know when to irrigate and how much water to apply at an irrigation. He needs information with reference to the different types of soil so that he may adopt the right procedure for the several types of soils found on his farm. He will need to know the relationship between the yields, the amount of water applied, the number of irrigations, the intervals between irrigations and the moisture content of the soil throughout the growing season.

The irrigation experiment station at Prosser is now studying the application of water to alfalfa at different time intervals. A series of "water relation experiments" is being conducted to furnish information relative to the amount of water needed at an irrigation. A very important study is under way to determine the field soil water holding capacity of the various types of soils. This will show the amount of moisture before and after irrigation in the first six feet of soil, and so far has shown that the water holding capacity of the soil, 24 to 48 hours after irrigation, as determined by an average of all samples, was 2.77 inches for the first foot, 3.52 inches for the second foot, and 3.27 inches for the third foot.

O. L. WALLER

Professor Waller, who has written the accompanying article on the service to irrigation of Washington State College, is vice-president of that institution, and head of its department of civil engineering. A more complete outline of his career appears in our Contributors' Department.

Tests Are Significant

The soil under test showed a water holding capacity of three and one-half inches of water per foot when saturated in the field, and two and one-half inches under conditions of equilibrium after being thoroughly irrigated. This means that the upper six feet of soil will hold fifteen acre inches of water before there is any loss due to deep percolation. This shows a considerable storage capacity in the soil itself. The experiments further showed that one-half inch of water per foot was necessary to have any available water for the crop plants.

In a number of places in the state for late fall and early spring irrigation, considerable water is available if it could be stored in the soil itself, but in some cases the expense of storage in reservoirs would preclude its use.

Fall and Spring Tests

The station is at work on a series of experiments to determine the effect of fall and spring irrigation upon crops. The fall and spring irrigation of alfalfa and corn has been carried on for several years. In 1925, the alfalfa yields did not show a noticeable increase or decrease due to fall irrigation. The corn plats, however, were irrigated in the spring before planting and showed an increase of 11.7 bushels per acre over the average of the plats that were fall irrigated.

These experiments will be continued on different types of soil to get information that will be useful to projects wishing to store winter and spring run-off in the soil that is to be cropped the following season. Such experiments should be valuable in the development of a considerable acreage of land that is now not irrigated, which could be irrigated from the late fall and spring run-off from adjoining streams.

Some demonstrations are needed to teach the farmer what amount of soil moisture is needed at all times to provide for the most thrifty growth.

Better Results Expected

The several types of soil at the Prosser experiment station make possible such a study and demonstration. There is a big difference between the amount of water on a saturated soil from which the air has been driven out and the plants are stunted and one that is so dry that the plants are wilting. These two extremes are frequently seen but always to the detriment of the growing crop. Somewhere between these two extremes there is a quantity of irrigation water which will produce the largest marketable yields and here is where the experiment station can render a very great service. The farmer cannot afford to experiment but the station can. It should not only gather such information but should teach the farmer how to use it.

Some simple method of determining the proper amount of water required for the best yield is much needed; a method that the farmer himself can use in determining the amount of water needed by the crop, on any type of soil. If the beginner in irrigation could have such information and be advised as to the crops adapted to his lands and climate, many failures would be avoided.

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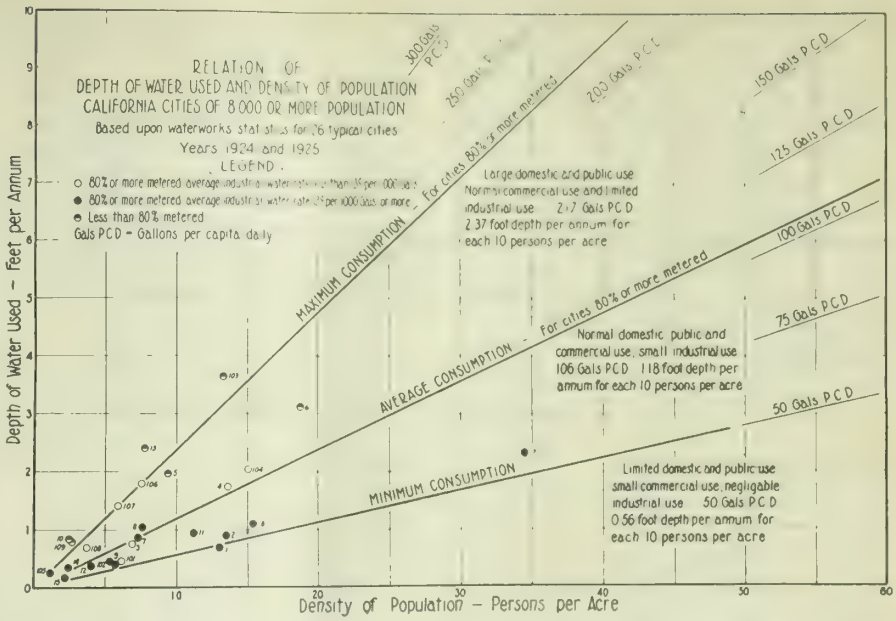
RELATION OF
DEPTH OF WATER USED AND DENSITY OF POPULATION
CALIFORNIA CITIES OF 8,000 OR MORE POPULATION
Based upon waterworks statistics for 76 typical cities
Years 1924 and 1925
LEGEND
80% or more metered average industrial water rate less than 35 per 1000 cubs.
80% or more metered average industrial water rate 35 per 1000 cubs. or more
Less than 80% metered
Gals P C D = Gallons per capita daily
MAXIMUM CONSUMPTION
For cities 80% or more metered
300 Gals P C D
250 Gals P C D
200 Gals P C D
150 Gals P C D
125 Gals P C D
100 Gals P C D
75 Gals P C D
50 Gals P C D
Large domestic and public use
Normal commercial use and limited industrial use 2.17 Gals P C D
2.37 foot depth per annum for each 10 persons per acre
AVERAGE CONSUMPTION
For cities 80% or more metered
Normal domestic public and commercial use, small industrial use
106 Gals P C D 1.18 foot depth per annum for each 10 persons per acre
MINIMUM CONSUMPTION
Limited domestic and public use small commercial use, negligable industrial use 50 Gals P C D
0.56 foot depth per annum for each 10 persons per acre
Depth of Water Used – Feet per Annum
Density of Population – Persons per Acre

Relation of Depth of Water Used and Density of Population, California Cities of 8,000 or More Population.

Area used as Common Factor in Estimating Water Needs of Cities

By CHARLES H. LEE

*Consulting Hydraulic Engineer, San Francisco**

PERHAPS the most complex of all water consumption problems which waterworks officials and engineers are called upon to answer, is the future water requirement of metropolitan areas. Such areas will always be composed of distinctive units, some urban or suburban residential, some commercial or industrial, and some rural or recreational. Each will have different water requirements, the amount of which in many cases will be wholly unrelated to the number of individuals resident upon such areas.

This problem has already come to the front in California in the metropolitan districts of Los Angeles and San Francisco-Oakland, and will later arise in the metropolitan areas which are beginning to surround San Diego and other rapidly growing cities. Recreational areas such as those about Monterey Bay and Santa Barbara also have this problem to meet.

There has thus arisen a definite need for some simple basis of estimating, other than population, which can be applied to all varieties of use and yet be related to some common factor. The problem has presented itself to the writer on several occasions and much thought has been given to it.

Solution Proposed

As a solution, it is proposed to use area as the common factor instead of population, with equivalent depth of water delivered to the area as the measure of the requirement. This method has long been established in irrigation practice, the amount of water used being expressed as depth over the cropped area, the term "water requirement" or "duty of water" having come extensively into use in this connection. The area being served by a given waterworks system and the quantity of water delivered both being easily obtainable, it would seem feasible to determine the depth used per unit area, whether the use be for general municipal or for industrial or irrigation purposes.

Analysis of waterworks statistics on this basis seems not only to yield results of value for use in estimating future consumption, but also to furnish a new and useful basis for comprehensive analysis and comparison of such statistics.

The mathematical relations of per capita consumption and depth can be very easily expressed in a formula which includes population density.

If Q=total annual water consumption in gallons
C=daily per capita consumption in gallons
A=area served in acres
P=population
p=population density
D=depth of water in feet per annum consumed upon service area

$$\text{Then } D = \frac{Q}{A \times 325{,}850} = p\ C/890$$

$$\text{and } C = 890\ D/p$$

New Method Illustrated

In other words, the depth of water consumed per annum upon a given service area is directly proportional to both population density and per capita water consumption, while per capita consumption is directly proportional to depth of water consumed and inversely proportional to population density. By means of these equations, if population density is known, it is possible to convert per capita statistics into depth, and vice versa.

This paper gives the results of determinations of the depth of water used per acre per annum in general municipal service. It also illustrates a new method for analysis of water consumption data, which, it is believed, will be suggestive to both waterworks officials and the engineering profession. The writer desires to acknowledge and express his appreciation of the assistance furnished by various waterworks officials in California who were asked to furnish data. It is hoped that the paper will serve to bring forth additional information on this subject and help to stimulate the systematic reporting of the acreage of service areas.

Water Demand Statistics

The consumption of water from public waterworks systems, whether municipally or privately owned, includes both that used for domestic and public purposes, and for the needs of business and industry. It also includes loss and waste from distribution systems and service connections.

In the average American city practically all domestic water is furnished from the public supply, and as the amount depends directly upon the number of people using water, it can be readily expressed on a per capita basis. An average for the United States under modern conditions is considered to be 30 to 35 gallons per capita per day, although where garden and lawn irrigation is practiced, as in California, this amount may be considerably exceeded.

To this should be added public use for fire protection, sewer flushing, street sprinkling, parks, etc., varying from 5 to 10 gallons per capita per day in various cities. The minimum demand up-

*Except from a paper read before the annual convention California Section, American Water Works Association.

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on any waterworks system may thus be considered as from 35 to 45 gallons per capita for the population within the service area, plus the requirements for gardens and lawns in regions where irrigation is necessary.

Industrial Demand Varies

The use of water for commercial and industrial purposes is in addition to this minimum and varies greatly in different cities, particularly that for industrial operations. This variation is due to the differences in manufacturing processes, the differing extent to which industries are established and the extent to which local sources are in use. In connection with the latter, the relative cost of water from the public system and from local sources, such as wells, is the important controlling factor.

In cities where local sources are cheaply developed and pumping plants can be operated at small cost in conjunction with other equipment, the industrial demand upon a public water system is small. On the other hand, where the public supply is furnished for industrial use at a low rate, or local sources are not available, practically all such users within the city draw from the public supply. The percentage which commercial and industrial use bears to the total is therefore extremely variable, statistics indicating a range of from 15 to 65 per cent. These facts are all well known to waterworks men, but are so pertinent to the analysis of statistics which follows that emphasis seems desirable.

General Municipal Service

Separate study has been made of the depth of water in general municipal service, and in special services such as domestic, commercial and industrial. For general service, the data available is limited to the total volume of water consumed for all purposes as contained in routine waterworks reports. The recent files of the Journal of the American Water Works Association and Municipal Index for 1925 and 1926 were extensively referred to in obtaining such information. Data for many California cities was also obtained by correspondence.

It has never become customary to report service area acreage, and such information can only be obtained by direct contact with department officials. This has been done in the case of many California cities. For other cities where data were not so obtained, the land area within municipal boundaries, as published in the latest annual reports of the U. S. Census Bureau, has been used.[1] This area does not in all cases represent waterworks service area, but it is believed to be sufficiently accurate for the purposes of this paper.

Data has been assembled for 103 typical American cities of 50,000 population and over, and for 26 California cities with a population of 8000 or more (See table 1). The data includes area and population served, total water consumption, population density, per capita consumption, and acre consumption in gallons and feet depth.

Wide Range of Demand

Preliminary study of the data showed a wide range in rate of water consumption for different cities and suggested broad classifications for detailed study, as follows:

1. *Geographical.* American cities, 50,000 or more population, and California cities 8,000 or more.
2. *Metering.* Cities 80 per cent or more metered, and those non-metered (25 per cent or less).
3. *Industrial water rates.* Cities 80 per cent or more metered with water rates for industrial use, 13 cents or more per 1000 gallons for average amounts consumed monthly, and those with rates less than 13 cents.

The method of analysis followed has been graphical. Diagrams were prepared with depth of water served over the service area in feet per annum as the vertical scale, and density of population expressed as persons per acre for the horizontal. Each plotted point represented a city, the index number corresponding to that on the tables.

Lines representing average, minimum, and maximum consumption were then drawn to conform with the plotted points. These lines pass through the zero point and their slope represents the increase of depth of water delivered for increase in population density. They can also be described in terms of per capita consumption, as is indicated by the form of the equation expressing the relation between depth, density and per capita consumption.

The position of lines equivalent to various rates of per capita consumption in gallons per day were indicated on the margin of all diagrams, thus facilitating the correlation of data when expressed either on a population or area basis. Separate diagrams were drawn for 103 American cities, and 26 California cities. The classification as to rates for metered cities was indicated on each diagram by means of conventional signs.

American Cities Metered

The total population served by the 95 typical waterworks in American cities metered is 17,829,091. The per capita daily consumption varies from 46 to 209 gallons for the various cities, and averages 95 gallons. The range of depth is from 0.1 to 4.58 feet per annum, the latter being for cities of densest population. The arrangement of the plotted points on the diagram clearly indicated the direct proportional relation between depth of water used and density of population. The average, minimum and maximum lines have the following values:

Line	Rate of depth increase per annum for each 10 persons Feet	Daily per capita consumtion Gallons
Average	1.07	95
Minimum	0.56	50
Maximum	1.68	150

It is a well recognized fact that the demand for water for industrial use is very sensitively influenced by the rates charged. When the figures for American metered cities were plotted it was discovered that cities where the industrial rate exceeds 13 cents per 1000 gallons lie below the average line, while point sat which the rate is less than 13 cents lie above. With more detailed information regarding the relative amounts of water used for various purposes, a diagram of this type would furnish an unusually comprehensive background for the comparative study of water consumption statistics in various cities.

Information regarding the characteristics of various cities, whether residential, commercial or industrial, would also be useful. For example, the normal density of population of built-up residential cities whose population is largely house in one-family dwellings, is from 8 to 10 persons per acre. This density corresponds on the diagram to a depth of approximately 1 foot per annum for average per capita water consumption.

In communities with average water consumption, if the depth of water delivered exceeds 1 foot per annum, it may be concluded either that a considerable portion of the population is living above the first floor level in flats, apartments, hotels or tenement houses, or that the commercial and industrial demand is greater than average. Both factors often act jointly to increase the depth of delivery.

Similarly, depths less than 1 foot indicate a partially built-up city or one in which industrial use is small. In a residential city it may also be indicative of the general absence of house gardens.

American Cities, Non-Metered

The relative amount of water used by eight American cities of 50,000 or more population, with small per cent of metering (25 per cent or less) was also plotted. The total population served by these cities is 13,799,000 and the average per capita consumption 167 gal-

(1) Financial Statistics of Cities, U. S. Census Bureau 1923, Table 1, and various bulletins.

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Table 1—Summary of Water Consumption Data for California Cities—1924 and 1925

No.	City	Area Served: Acres (d)	Population: Total	Population: Per Acre	Water Consumption: Total Million Gallons Per Year	Water Consumption: Per Capita Gallons Per Day	Water Consumption: Per Acre Gallons Per Day	Water Consumption: Per Acre Annual Depth, Ft.	Water Consumption: Per Cent Metered
101	Alhambra	4,060	25,000	6.15	1,645	66	406	0.46	100
1	Belvedere Water Corp.	3,840	50,000	13.0	842	46	607	0.68	
2	East Bay Cities	37,000	498,000	13.5	10,766	58	796	0.89	100
102	Eureka	3,731	20,000	5.36	1,500	75	402	0.45	98
103	Fresno	5,432	72,000	13.3	17,500	244	3,246	3.64	8
3	Glendale	7,000	48,500	6.9	1,706	96	670	0.75	
104	Long Beach	9,309	140,900	15.05	17,000	121	1,820	2.04	100
4	Los Angeles (b)	80,960	1,100,000	13.6	45,996	109 (c)	1,555	1.74	97
5	Modesto	1,940	17,500	9.4	1,248	195	1,760	1.97	3
6	Marysville	400	7,500	18.8	408	149	2 790	3.12	0
7	Pasadena	12 000	87,736	7.3	3,372	105	770	0.86	100
8	Palo Alto (a)	1,020	7,731	7.6	347	123	928	1.04	100
9	Redwood City	1,500	8,500	5.7	190	61	348	0.39	100
10	Redlands	6,400	16,000	2.5	1,732	296	741	0.83	64
105	Riverside	25,088	30,000	1.16	5,750	190	220	0.25	90
106	San Bernardino	4,365	33,000	7.55	7,000	212	1,600	1.79	97
107	Santa Ana	5,573	33,000	5.91	7,000	212	1,254	1.41	100
108	Santa Barbara	8,051	29,600	3.68	5,000	169	622	.70	93
109	Santa Cruz	5,702	15,000	2.63	4,000	266	700	.79	75
11	Stockton	4,480	50,000	11.2	1,370	75	840	0.94	100
12	San Jose, Los Gatos, etc.	20,000	80,000	4.0	2,339	80	322	0.36	80
13	Sacramento	8,960	70,000	7.8	7,028	274	2,140	2.4	0
14	San Diego	44,800	106,047	2 4	4,894	126	304	0.34	100
15	San Mateo	4,800	10,500	2.2	263	68	152	0.17	91
16	Santa Rosa	1,339							
17	San Francisco	16,170	557,530	34.5	12,191	60	2,070	2.32	100
18	Vallejo	1,725	26,641	15.4	620	64	980	1.10	
	Total		3,139,785			3,541			
	Average					132			
	Total—80% or more metered		2,941,785			2,117			
	Average—80% or more metered					106			

NOTE: Data for cities numbered 1 to 18 obtained by correspondence. Data for cities numbered 101 to 109 obtained from Municipal Index 1925 and 1926.
(a) Data for 1922.
(b) Excluding San Fernando Valley, Elysian and Griffith Parks and shoestring strip.
(c) Average for years 1920-1924.
(d) Service area for citizens numbered 1 to 18, land area; within political boundary for cities numbered 101 to 109.

lons per day. The latter is 75 per cent greater than the average for cities 80 per cent or more metered. The points in the diagram were so scattered that no attempt was made to draw an average line.

Record of California Cities

The determination of depth for California cities was made largely on the basis of service area, since, in many cases, considerable unused land was included within the municipal boundary. There being fewer points to the plot, the diagram printed herewith includes both metered and non-metered cities.

The total population served in the 26 selected cities is 3,139,785, of which 2,941,785 are in cities 80 per cent or more metered. The average per capita consumption for twenty cities of the latter class is 106 gallons daily, which is 11 per cent greater than for the 95 American cities of 50,000 and over. The maximum is 217 gallons daily or 45 per cent greater. The difference is largely due to the greater use of water for lawns and gardens in the average California city. Average, minimum and maximum lines have been drawn on the diagram with the following results:

Line	Rate of depth increase per annum for each 10 persons Feet	Daily per capita consumption Gallons
Average	1.19	106
Minimum	0.56	50
Maximum	2.44	217

Rates for water for industrial use have the same influence upon water consumption as in American cities generally. The effect of meters in reducing loss and waste is also apparent. In addition to having a greater rate of water consumption, California cities differ from the average American city in having a relatively small industrial demand. The use of water for irrigation of lawns and gardens appears to be great enough to more than offset the deficiency in industrial demand. This fact points to a material increase in future demand in California cities which may be fortunate enough to have rates low enough to attract industry.

A tabulated summary of all data compiled for American and California cities has been prepared herewith as Tables 2 and 3. These tables set forth the depth of water used in general municipal service in feet per annum for minimum, average and maximum consumption, and for densities of population from 5 to 50 per acre. Their field of application is in estimating future water consumption in self-contained community units. The data does not apply, however, to special services and segregated areas, such as strictly residential, industrial or agricultural. For such, the results of special tests are necessary.

Waterworks reports are usually lacking in information regarding the use of water for special purposes, such as domestic, commercial or industrial. The rate of per capita consumption, as determined from statistics in such reports, is a composite made up of all varieties of use, and throws but little light upon any one type. The only available source for such data are reports of special tests. With the increased tendency toward zoning, as stimulated both by city and regional planning programs, more detailed information is coming to be in greater demand. The following specific data for consumption in California cities has been obtained from various sources, and will be presented (in a forthcoming issue.—Ed.) in the hope that it will stimulate the more systematic collection and publication of such information. In addition to other uses, such data would be very valuable in distribution system design.

TABLE 2—AVERAGE WATER CONSUMPTION FOR TYPICAL AMERICAN CITIES 80% OR MORE METERED EXPRESSED AS DEPTH OF WATER OVER SERVICE AREA

Density of Population	Depth of water over service area—feet per annum: Minimum Consumption 50 gals per capita	Average Consumption 95 gals. per capita	Maximum Consumption 150 gals. per capita
5	0.28	0.54	0.84
10	0.56	1.07	1.68
15	0.85	1.60	2.53
20	1.12	2.15	3.37
25	1.40	2.67	4.22
30	1.68	3.20	5.05
35	1.97	3.73	5.90
40	2.25	4.26	6.75
45	2.53	4.80	7.59
50	2.81	5.34	8.44

Data based upon curves drawn for 95 typical cities (Diagram 1).

TABLE 3—AVERAGE WATER CONSUMPTION FOR TYPICAL CALIFORNIA CITIES 80% OR MORE METERED, EXPRESSED AS DEPTH OF WATER OVER SERVICE AREA

Density of Population	Depth of water over service area—feet per annum: Minimum Consumption 50 gals. per capita	Average Consumption 106 gals. per capita	Maximum Consumption 217 gals. per capita
5	0.28	0.58	1.18
10	0.56	1.16	2.37
15	0.84	1.78	3.55
20	1.12	2.37	4.74
25	1.40	2.97	5.92
30	1.68	3.56	7.10
35	1.96	4.16	8.29
40	2.23	4.76	9.48

Data based upon curves drawn for 20 typical cities (Diagram 3).

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The EDITORIAL

MODERN Irrigation

Reg. U. S. Pat. Off.
Published Once a Month
AT LOS ANGELES, CALIFORNIA, BY THE
PETROLEUM WORLD PUBLISHING CO. *Editorial and Executive Offices, 626 South Spring Street, Telephone Broadway 3262.* Branches: CHICAGO—1163 MONADNOCK BLDG., *Telephone Wabash 8855;* JOSEPH E. O'CONNOR, *Manager.* NEW YORK—56 W. 45TH STREET, ROOM 1105, *Telephone Vanderbilt 3672;* WERNER HAUPTLI, *Manager.*

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By Annual Subscription in the United States and possessions, $2.00; Foreign, $2.50; Single copies on sale in the irrigation country, 20 cents. In ordering change of address, give both the old and the new address. Allow ten days for re-entries on the subscription list. Advertising rates and circulation data upon request. Checks should be made payable to Petroleum World Publishing Co.

Vol. II NOVEMBER, 1926 No. 11

Water Seers

NOWHERE is the problem of estimating future needs so important or so difficult of solution as in the field of irrigation and its allied field, waterworks. The problem of determining the amount of water which will be required for the years to come presents itself whenever a new irrigation project is undertaken or a step taken to provide additional domestic water supply.

A summary of the recent trend of thought in these fields is surprising in its revelation of the extent to which men are looking to the future. The mushroom growth of the West has taught its lesson to those who are responsible for the management of waterworks and reclamation projects. "Tomorrow" comes sooner in the West than it does anywhere else.

Then too, from the standpoint of costs, as one hydraulic engineer has recently pointed out, it is often desirable to design and build major structures for the ultimate supply in order to meet the requirements of economy. Expenditures for water rights and lands become necessary long in advance of actual need. It is quite common, in fact, for large cities to look ahead 40 to 50 years in their municipal water construction problems, and where located in regions of limited supply the acquisition of lands and water rights from 75 to 100 years in advance is not unusual.

RECENTLY there have been several manifestations of this growing tendency to look to the future. In the field of reclamation and irrigation Herbert Hoover is probably the foremost exponent of the theory that new irrigation works must be built before the actual need is felt. The keynote of the Secretary's recent western trip was the urgency of looking to future needs in developing the nation's water resources, a stand on which he has been opposed by many who are unable to visualize the future or who lay the troubles that befall the farmer to overproduction more than to distribution and marketing.

Waterworks men, too, are giving voice to the need for looking to the future. Those who attended the recent convention of the California Section of the American Water Works Association at San Diego must have been impressed with the theme of the three speakers who came to tell of the work of the three metropolitan areas of San Francisco, Los Angeles, and San Diego. Incidentally, their papers told of what *had been* done, but primarily they told what *is being* done and what *will be* done in anticipation of future needs. There were no post-mortems over the past, but rather intelligent discussions of anticipating the needs of people not yet born.

This is a happy sign. Stories of individual successes generally attribute these successes, among other things, to vision. The man who is thoughtful enough to prepare for tomorrow, for the job ahead, is the one as a rule who attains success. Likewise, the success of nations depends in considerable measure on this attribute; and the way these western United States, the baby states of the Union, are envisioning the years to come in their water developments is reasurring evidence that the future of the nation will be well taken care as far as that all-essential requisite of life—water—is concerned.

Oregon Goes Ahead

OREGON is going about the solution of its reclamation problems in a business-like manner judging from the accomplishments of the sixteenth annual session of the Oregon Reclamation Congress. The state is developing a state-wide organization for orderly reclamation and the relief of settlers on sick projects.

It is interesting to note the principals enunciated by the Congress in reply to its legislative committee for constructive suggestions. It was declared:

1. That the State be not called upon to assume the liabilities of irrigation districts.

2. That the control of all reclamation matters be vested in the State Irrigation and Drainage Securities Commission.

3. That provision be made to prevent pyramiding of taxes so that settlers will be protected and the obligations of each limited to a definite fixed sum.

4. That legislative machinery be provided to permit and encourage the pooling of all interests involved on any project wherein default has occurred, to the end that constructive cooperation may be secured.

"Western Waterworks" Begins on Page 25

POINT *Of* VIEW

5. That such amendments be made to the present irrigation district law in the matter of payment of operation and maintenance charges so that the district's officers may have the option of collecting such charges in advance instead of through the county officers, as now provided, and that they have the further option of denying water to the settlers until such charges are paid, provided that such action will not release the land from the lien of operation and maintenance charges once levied.

6. That on any new irrigation district projects which may be undertaken, and on existing projects, as far as possible, assessments should be made in proportion to the benefits to be derived from the water right supplied.

7. That operation and maintenance charges be based upon a fixed charge for the first unit of water supply and an additional charge based on additional quantity of water delivered.

8. That the foreclosure of delinquent tax certificates follow the form or practice now followed by the County Courts in the foreclosure of delinquent general taxes, to the end that the procedure may be simplified and the cost to the irrigation district lessened.

9. That an immigration department be created for the purpose of assisting in the colonization of all projects.

The irrigationist interested in management problems will find in these nine points a broad legislative program that, while it contains several good ideas for the benefit of reclamation, will probably require a long time to complete, if one bears in mind the speed of legislative machinery. What Oregon is trying to do is to follow up its campaign of getting colonists to come to the state by providing a management of its projects that will keep people on these projects after they come. Progress is being made and reclamationists in the state are to be congratulated on the spirit of cooperation and mutual understanding manifested in their recent meetings.

Championing the Settler

MODERN IRRIGATION recently published in these columns its comment on the government's action in charging off $27,000,000 as a definite loss on reclamation projects that have failed ostensibly because of poor soil conditions. The question was asked, "Is It Worth It?"

C. S. Heidel, Montana State Engineer, writes to the editor his belief that a more complete analysis of the situation would show up the settler in a better light than this journal has pictured him.

"There is," explains Mr. Heidel, "a condition that we sometimes fail to consider; namely, that some of the settlers on Federal projects have lost their savings and ruined their lines in attempting the impossible task of working farms which, because of soil conditions or other reasons, can not now be farmed successfully.

This condition, our critic points out, was referred to in Dr. J. A. Widtsoe's paper printed in Modern Irrigation for March. "It is," he continues, "manifestly unjust to farmers who are now settling on or have managed to stay on productive portions of projects to saddle them with an overhead charge to pay for works constructed on other land which can not be profitably farmed. If the Secretary of the Interior and the Commissioner of Reclamation are permitted to delay construction of future projects until economic considerations warrant their development there will be little probability of later need for the cancellation of construction charges on such projects."

"In discussing the cancelled and suspended payments," concludes this writer, "we should not forget the ruined settlers who have lost their fortunes in attempting the impossible. I feel that a full consideration of irrigation history leads to a conviction that present settlers should not be forced to bear an undue proportion of the expenses caused by early errors or mistakes on the part of others."

Our Montana reader's point is well-taken, without doubt. Much of the loss on reclamation projects must be charged to poor soil rather than poor farming. A complete confidence in their government's wisdom and judgment has caused many farmers to settle on lands that never will produce profitably and in these instances surely the settler cannot be held responsible for the loss which the taxpayer must shoulder.

As Dr. Widsoe points out, in the article referred to above, colonization wisdom demands that the projects to which prospective settlers are invited are inherently capable of successful development. But—the prospective must be selected according to his fitness to live and labor under prevailing project conditions. It takes a man of distinct gifts to become a successful farmer. This fact must not be overlooked by those who champion the settler's cause.

"Danger" from Reclamation

SECRETARY of the Interior Work says that he is not disturbed by charges from agricultural States that we are at present over-producing in agriculture beyond the demand for our products, with correspondingly lowered unprofitable prices to the producer in this connection.

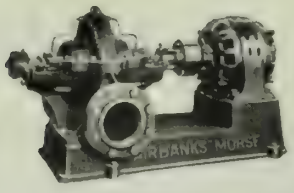
He declares that "we have been developing Federal reclamation in the West for 25 years and what we have produced is negligible when compared with the production of the whole country. The 1,242,750 acres on Government irrigation projects, last year produced crop values of $96,100,000. When these totals are compared with 372,000,000 acres farmed in the entire United States worth $13,031,000,000, we may safely ignore the immediate danger from reclamation."

He adds, "we should look to the future—25, 50 or more years distant—rather than now, as the bringing in of new land is a slow process at best."

It is a well recognized fact that the direction of the first step is more important than the length of it.

If there is any danger from reclamation it is in our failure to make complete use of water resources. Yet, as another authority has said, "we must have for each decade a practical economic duty of water according to our time and conditions. The broad principle of beneficial use will allow adjustments from one decade to another that will permit taking up and utilizing waste."

"Western Waterworks" Begins on Page 25



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Atkinson and Spicer Lowest Bidders on Coolidge Dam

Construction Is of New Multiple Dome Type; Los Angeles Firm Submits Figure of $2,268,525.50

Bids have been received by the United States Indian Irrigation Service to build the Coolidge Dam near San Carlos, Arizona. Low bid to erect the structure was submitted by the Atkinson & Spicer Company, of Los Angeles, at $2,268,-525.50. Nine bids were submitted.

The site for the Coolidge Dam is located at the entrance to Box Canyon on the Gila River, nine miles south of San Carlos. It will impound approximately 1,200,000 acre feet of water to be used to irrigate about 100,000 acres of land. The land to be irrigated lies in the vicinity of Florence and Casa Grande and is owned partly by the Pima Indians on the Gila River Indian Reservation.

Dimensions of Dam

Rising 250 feet in height the dam will have a width of 300 feet at the base and 600 feet at the crest, and will be 110 feet thick at the base. Constructing the dam will necessitate the removal of approximately 209,000 cubic yards of material and the structure will involve 190,-930 cubic yards of reinforced concrete which will require the use of 223,300 barrels of cement and 2250 tons of reinforcing steel.

Contract to build the dam, which will be a new type known as the multiple dome dam, will be awarded within thirty days and the contract to execute the work provides for completion of the dam before June 1, 1929.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912.

Of Modern Irrigation published monthly at Los Angeles, California, for October 1st, 1926.

County of Los Angeles } ss.
State of California, }

Before me, a Notary Public in and for the State and county aforesaid, personally appeared Walter C. Monroe, who, having been duly sworn according to law, deposes and says that he is the Business Manager of the Modern Irrigation, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 411, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are:

Publisher—Petroleum World Publishing Company, Los Angeles, California.

Editor—Russell R. Palmer, Los Angeles, California.

Business Manager—Walter C. Monroe, Los Angeles, California.

2. That the owner is: (If owned by a corporation, its name and address must be stated and also immediately thereunder the names and addresses of stockholders owning or holding one per cent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a firm, company, or other unincorporated concern, its name and address, as well as those of each individual member, must be given.)

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3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are: (If there are none, so state.) None.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in case where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

5. That the average number of copies of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers during the six months preceding the date shown above is .....(This information is required from daily publications only.)

WALTER C. MONROE.
Signature of Business Manager.

Sworn to and subscribed before me this 21st day of September, 1926.

(Seal) G. ROY PENDELL.

(My commission expires May 23, 1928.)

Holtville Installs Jetties

Holtville division of the Imperial Irrigation District, California, received 18,618.11 second feet of water during the month of October, according to the report received at the district offices. Deliveries in the division for the month totaled 11,376.16 second feet, an increase of 6,530 second feet over the same period in 1925 and approximately the same amount delivered in September, 1926. The payrolls total for the month is shown as $11,710.46, with 110 employes. The installation of a number of Kellner jetties at points in the Alamo river channel occupied the attention of crews during the month. These jetties are said to be proving effective in opening up new channels capable of carrying off the full flow of the river.

Mexico Plans First Project

Plans for the first project in connection with the irrigation program of the Mexican Government have been completed, according to information recently received at the U. S. Department of Commerce from George Wythe, acting commercial attache at Mexico City. It is said that the first project to be carried out will be undertaken near the head waters of the Lerma River in the northeast corner of the state of Michoacan, Mexico. Plans are being prepared, it is reported, for a great masonry dam to be built across the Rio Lerma at Tepuxtepec, in the municipality of Contepec, behind which will be stored 500,000,000 cubic meters of water for use in a great irrigation and hydro-electric power development.

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THE HYDRAULIC DIGEST

A Monthly Bulletin Board of Brief Facts and Events from Far and Near

El Camino Votes Bonds

El Camino Irrigation District, California, recently voted $420,000 bonds for completing the laying of underground pipes for the irrigation of 7,500 acres. Fred H. Tibbetts, of San Francisco, is the engineer in charge.

La Salle Wants Canal Bids

La Salle County, Texas, Improvement District No. 1, through W. A. Kerr, secretary of the board of directors, has asked for bids on 100 miles of main canals, 175 miles of laterals, and approximately 2 miles earthen reservoir dam across the Nueces River.

Flood Control Bonds Defeated

The proposed $26,000,000 bond issue for more extended development of the Los Angeles County Flood Control District was defeated at the election of November 2. This proposed issue was to supplement the work begun two years ago, when an issue of $35,300,000 was passed.

LaConner May Buy System

The city council of LaConner, Washington, is considering the question of purchasing the local water system. The present owners are desirous of selling and are unwilling to invest any more money in the plant for needed improvement. Under existing conditions, the council reports, the best outlook for development of the system is in municipal ownership.

San Carlos Would Buy System

The San Carlos, California, Chamber of Commerce, recently passed a resolution urging the purchase of the plant and properties of the San Carlos Water Company. The proposal recommends that San Carlos take over the entire system of the company and that additional wells be installed in order that the community may have sufficient water supply for its increasing population.

Turlock Will Vote on Bonds

The Turlock Irrigation District, California, through its board of directors, has fixed December 1 as the date for submitting a bond proposition of $514,000 to the taxpayers for a vote. The funds derived from this issue, it is planned, will be used for installing two additional units at the Don Pedro Dam power plant.

Raise Water Rates 50 Cents

The Grass Valley, California, city council recently voted to increase water rates for the city by the addition of 50 cents to each $1.28 monthly charge, and to devote this sum to needed replacements, betterments and extensions of the system. The distribution system is owned by the city, water being bought at wholesale from a power company.

Ojai Plans Flood Control

A proposal that a county-wide survey be made of the water resources in Ventura County, California, with a view to the conservation of these resources and their just apportionment throughout the county has been made by those interested in forming a water conservation district at Ojai. The Ojai conservationists propose to form a district in Horn canyon and construct a series of check dams to hold the water through underground storage. The district would comprise the lower valley and the upper valley as far as the Santa Ana.

Two States Reject Water Bills

Oregon and California voters defeated proposed constitutional amendments for state development of water and power resources. The California bill proposed a state bond issue of $500,000,000 for state-owned and operated water and power developments. The Oregon bill proposed creation of a board of five elective members with full authority for the conservation, development, storage and distribution of electric energy and water for domestic and irrigation uses, and a bond issue not to exceed 5 per cent of the state valuation.

Filter System in Good Order

Post-season inspection of the Sacramento filtration plant, just completed by Alan J. Wagner, city engineer, shows the plant to be in good condition. Only a few minor cracks were found in the sedimentation basin, which was completely drained for the inspection. Although the plant was designed for a maximum daily output of 32,000,000 gallons, on several occasions during the summer 45,000,000 are said to have been used. Construction on the additional filtration beds may be delayed until spring because of the questioned validity of the bonds voted for the work.

Votes $3,065,000 for Water

The Roosevelt Irrigation District, Arizona, voted almost solidly for a bond issue of $3,065,000 on October 26. This new district comprises some 40,000 acres of land, much of which is classified as suitable for citrus fruits, and is served by the Southern Pacific railroad and the state highway to Yuma. It lies west of the Agua Fria river and extends from above the Buckeye district to the Hassayampa river. It is planned to irrigate

Condemns Cambria's Water

The San Luis Obispo county health department has given the citizens of Cambria until December 15 to secure a different water supply from that used at present, according to a recent report. This decision was made upon the advice of H. H. McCormick, sanitary inspector, who states the water is unfit for consumption because of the seepage of sewage. The present water supply is obtained from a system of wells, and the trouble has arisen, it is claimed, because the wells are not deep enough and the pipes are eaten with rust.

Railroads Tap Arizona Projects

Arizona irrigation projects are assured of the co-operation of the railroads in the development of the lands reclaimed from the desert. The Southern Pacific recently celebrated the opening of its new $15,000,000 line through Phoenix and the Salt River Valley; and the Santa Fe Coast Lines, through W. K. Etter, general manager, have announced the proposed construction of a branch line, fifteen miles in length, that will tap the news Beardsley irrigation project, comprising 40,000 acres in the Salt River Valley, 20 miles west of Phoenix. Grading for this line is expected to start by January 1, 1927.

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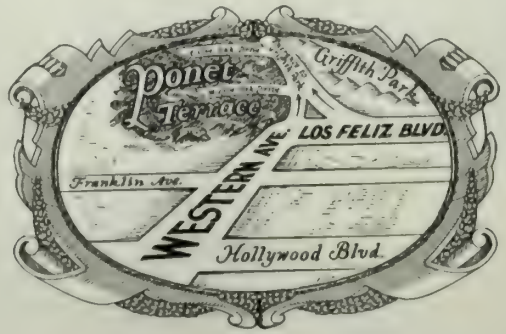


"Western Waterworks" Begins on Page 25

THE STAFF PHOTOGRAPHER RUNS AMUCK AT THE SAN DIEGO WATERWORKS CONVENTION

Left to right: (1) A. P. Lovell, supt. San Diego Water Dept.; and Frank M. Brooks, manager Art Concrete Works. (2) Geo. W. Pracy, supt. Spring Valley Water Company. (3) Thos. Henderson, supt. Sierra Madre Water Dept.; and S. B. Morris, chief engineer Pasadena Water Dept. (4) W. W. Stephens, supt. Santa Monica Water Dept.; E. L. DeRemer, supt. San Fernando Water Dept.; R. T. Hutchins, supt. El Segundo Water Dept.; and R. W. Keene, Hersey Meter Co., Los Angeles. (5) Modern Irrigation has a standing reward of one year's subscription to the journal to the one identifying all three figures in this group. It was too much for the camera man, apparently, as he turned in a blank for No. 5. (6) G. T. Reardon, Kennedy Valve Co., Los Angeles; C. A. Braslin, Neptune Meter Co., San Francisco; F. J. Henkenius, Kennedy Valve Co., San Francisco; W. F. Goble, supt. San Gabriel Water Dept. (7) F. J. Henkenius, Kennedy Valve Co.; H. M. Dudley, McWane Cast Iron Pipe Co. (8) R. T. Corey, manager Coos Bay Water Co., Marshfield, Ore.; A. Van Vechten, McWane Cast Iron Pipe Co.; and Louis Farrell, East Bay Water Co. (9) A. Van Vechten, McWane Cast Iron Pipe Co.; C. G. Claussen, B. Nichols Co.; and W. S. Conner, B. Nichols Co. (10) Walter Jones, James Jones Co.; and W. W. Conner, James Jones Co. (11) A. L. Frick, Jr., Alexander Bell, G. T. Luippold, all of Wallace & Tiernan Co.; (12) J. I. Prugh, supt. Sacramento Water Dept.; and R. A. Stevenson, chemist, Sacramento Water Dept.

WESTERN Waterworks
Supplement to Modern Irrigation
Of Interest Expressly to Waterworks Executives, Contractors, and Municipal Engineers

California Section's 7th Annual Convention Draws Big Crowd; Morris New Chairman

ALL records for attendance were broken at the seventh annual convention of the California Section of the American Water Works Association, held at San Diego, October 27, 28 and 29. From the standpoint of the interest manifested in the program and the exhibits, the meeting was also the most successful of any held since the inception of the Section some seven years ago.

Not only were members of the waterworks fraternity present from California, but there were registrants from several other Pacific Coast states and British Columbia as well. The complete roll call of the convention will be found on another page in this issue of WESTERN WATERWORKS.

It would be difficult to chronicle the complete proceedings of the convention in one issue of this publication, but an attempt has been made to cover, to some extent, all of the important phases of the three-day program. Many of the papers read before the meeting are reproduced on the following pages of WESTERN WATERWORKS, and others are scheduled for early publication. Special arrangement with the Journal of the American Water Works Association makes it possible for WESTERN WATERWORKS to publish these papers prior to their publication in the Journal.

Any story about the convention would be incomplete without mention of the exhibits of the manufacturers of waterworks equipment, an annual feature which always draws the interest of waterworks men, both at the California Section conventions and the national gatherings of the parent organization. When the convention was formally opened Thursday morning, the convention hall in Balboa Park, with its pleasing decorations and excellent exhibits was ready for inspection. Without doubt, the major share of the credit for the large number of exhibitors and the general excellence of the exhibits themselves goes to J. R. Barker, Pacific Coast manager of the Neptune Meter Company, who was chairman of the exhibits committee. Mr. Barker gave liberally of his time in interesting large numbers of manufacturers in displaying their products at the convention. In this work he was, however, very ably assisted by the other members of his committee.

Mueller's "triple threat."—Left to right: "Bill" Jett, Ward L. DeWitt and Thos. F. Leary of the Pacific Coast forces of the Mueller Company. Mr. Leary is Pacific Coast manager.

Credit for the lack of confusion attending the convention was due, in large measure, to A. P. Lovell, su-

(Cont. on P. 65)

Here and There
At San Diego

Professor W. F. Langlier, of the University of California, was among those present at the big show.

Bill Jett, the well-known representative of the Mueller Company of Los Angeles, was very much in evidence around the convention hall.

One wondered if the cast iron pipe men were endeavoring to make a good impression upon San Diego's city "dads." At least there was evidence of competition.

F. C. Finkle, consulting hydraulic engineer of Los Angeles, was seen taking in the show. Mr. Finkle, it will be remembered, was for many years chief hydraulic engineer for the Southern California Edison Company.

Among the many prominent and well known supply men seen was W. C. Mills, Pacific Coast sales manager for the General Chemical Company. Mr. Mills evidenced a keen interest in all of the convention's activities.

Arthur Crooke, of the Worthington Meter Company, Los Angeles, seemed to have his hands full piloting the extemporaneous orator of the evening. The Worthington Meter exhibit certainly created plenty of interest.

L. A. Safford and C. H. Johnson, of the De Laval Steam Turbine Company, were right there in explaining the efficiency of their pumps and telling of the arrangements they have at Los Angeles and San Francisco for quick servicing.

Another well known representative of the deep well turbine contingency was Joseph H. Cox, president of the Western Irrigation Equipment Association, and vice president in charge of sales for the Frank J. Kimball Company.

One of the outstanding booths at the convention was that of the James Jones Company with its striking background and interesting display of brass goods. W. W. Conner, known by waterworks men all over California, was in charge of the exhibit. Walter Jones also was seen about the convention hall.

Andrew Erwast, chief engineer of the Spreckles Company, San Diego, and Virgilio Bruschi, of the San Diego city council, do a little chinning.

R. W. Keene, W. L. King and Allen Jack, of the Hersey Manufacturing Company, must have a host of friends among the waterworks fraernity, judging by the company they were seen in at both the convention hall and the hotel.

O. C. Brand, representing A. D. Cook, Inc., of Lawrenceburg, Ind., evidently arranged for local representation in several parts of California for Cook deep well pumps, valves and hydrants as he was seen in deep conversation several times with different supply men.

R. F. Goudey, resident engineer, State Board of Health, Los Angeles, was with the bunch at San Diego. Mr. Goudey has been making some very interesting studies relative to the chlorination of irrigation water for the prevention of the transference of typhoid bacilli by green vegetables.

F. J. Henkenius of San Francisco, and G. J. Reardon of Los Angeles, represented the Kennedy Valve Company at the convention. These two were very active among the waterworks men, and made a host of friends.

The "Orpheus Four"—no, not Morpheus!—headed by H. M. Dudley, of the McWane Cast Iron Pipe Company, were certainly "there" with royal entertainment for the guests at the dinner dance on Friday evening. Mr. Dudley's voice is well known to a host of radio fans in Southern California and elsewhere in Radioland.

R. E. Brownell, general manager of the Palos Verdes Water Co., of the Palos Verdes Estates, did not let his in-

terest in water matters interfere with some opportunities to tell about the wonderful home-site project his company is developing near Los Angeles.

"Alex" Bell and his well known pipe were very much in evidence around the Wallace & Tiernan booth. There was always a crowd gathered about him, inspecting the working model that he was demonstrating, in cooperation with G. T. Luippold and A. L. Frick.

Since this was a waterworks meeting it is not strange that there were a number of Brooks in attendance. Frank Brooks of the Art Concrete Works was there assisted by his brother H. L. They had an interesting exhibit and took especial pleasure in showing their new number 65 box for large meters.

Geo. H. Bailey, Pacific Coast manager of the National Meter Company, was seen in animated conversation with several of the "big unit" buyers of water meters, so, in all probability, western sales records are due for another strong "upward turn," as they say on the stock exchange.

L. H. Chamberlain, Water Works Supply Company, says the speed cops around San Juan Capistrano are altogether too vigilant. The Water Works Supply Company was well represented at the convention. Among those present from this organization were C. B. Abbott, president; L. H. Chamberlain, Foster Manock, and E. A. Rutledge.

Among the well known figures at the convention this year, as in previous years, was Thomas Leary, Pacific Coast manlarge number of interested visitors.

ager for the Mueller Company, of Decatur, Illinois. "Billy" Jett, southern district manager, was another member of the Mueller staff who was much in evidence at Convention Hall and the various other get-togethers of convention week.

H. L. Dickinson, Pacific Coast man-

"I'm Only a Little Farmer Boy," the title of the oration delivered by James B. Howard, Earlimart, California, seemed to find either favor or flavor with all those who were included among the audiences.

ager, Chapman Valve Company, was taken ill while attending the convention, and had to leave early. O. J. Magary, represented the company, however, and was seen throughout the session. He thinks the convention was the best to date, as more interest was shown, both in the manufacturers' exhibits, and in the papers that were presented.

J. E. Lundy, general manager of the Sterling Pump Works of Stockton, California, and B. A. Tucker, sales manager of the Pacific Pump Works of Los Angeles, were among the pump men in attendance at the convention. Both are familiar figures at the bi-monthly meetings of the Western Irrigation Equipment Association and at all other gatherings of the irrigation and waterworks fraternity.

It is a long time since Eve handed Adam the apple, but C. B. Meskimons, of the Philbrook Spring Pipe Clamp Co., knows they still make a darn good "lure." He had a box of fine Oregon apples in his booth. If you were down at San Diego and did not get one—or more—it must have been your own fault. And, incidentally you lost an opportunity to examine a mighty good pipe clamp.

The Western Pipe & Steel Company went to a great deal of work to prepare their booth in the convention hall. Seven or eight men were employed nearly a whole afternoon in bringing in the large section of fabricated steel pipe that formed the "outer boundary" of the booth, so to speak. This company had a very attractive exhibit and their efforts were well rewarded, judging from the

Black Canyon Dam Site on the Colorado River, Looking Upstream.

Colorado Aqueduct Will Cost Los Angeles Less Per Capita Than the Owens Project

Outlay for Proposed Pipe Line Would Be from 150 to 200 Millions; Blythe Route the Best

By WILLIAM MULHOLLAND

Bureau of Waterworks and Supply, Los Angeles

THE City of Los Angeles is on the edge of a desert. You may go in any direction from the City of Los Angeles, north, south, east or west, and you will find the desert before you go very far,—the arid, grinning desert.

The City of Los Angeles had to go 250 miles to the north over three mountain ranges and across deserts and waste plains to the Owens River to get her last water supply.

Discusses Pumping Costs

We pump water in the City of Los Angeles. The criticism offered the proposed aqueduct from the Colorado River to Los Angeles is that we won't be able to pay the cost of pumping this water by the time we get it to Los Angeles. We know what it costs to pump water; our pumped water today is 80 million gallons a day. That is more than San Francisco and Oakland use, yet we pump that much. You cannot scare us with pumping water if we can get water with no very great taxation but that of pumping.

In addition to that the Colorado River carries with it the proposition of power development. There is tremendous power to be developed, and I will say that we propose to build a power plant. Fifteen hundred second feet will require just about a third of the power that will be developed in the building of the Boulder Canyon Dam. You cannot put power to better use as far as Los Angeles is concerned or as far as California anywhere is concerned, than to pumping water to be put to profitable use.

We can pump the water there if we get the power at cost plus the cost of operation, for five cents per hundred, for we are selling water today for 13 cents a hundred feet so there is a good margin before we reach the limit of twenty cents a hundred feet. They charge 25 or 28 cents in Oakland or San Francisco and I claim right now that that is cheap water. Why should a man get water, water the essential element of life, cheaper than it costs him to polish his shoes or pay for his telephone? The telephone rates in Los Angeles are far in excess of the rates for water. They should not be. We can stand to pay far more than we do for the water.

I am not protesting against the rates of the City of San Francisco or Oakland. I have always found that the rates are perfectly justified. The people who brought water there and entered into the enterprise of supplying those two great cities with water were justified in making the rates they did, rates which were made anyway by the railroad commission. If we can get water into the City of Los

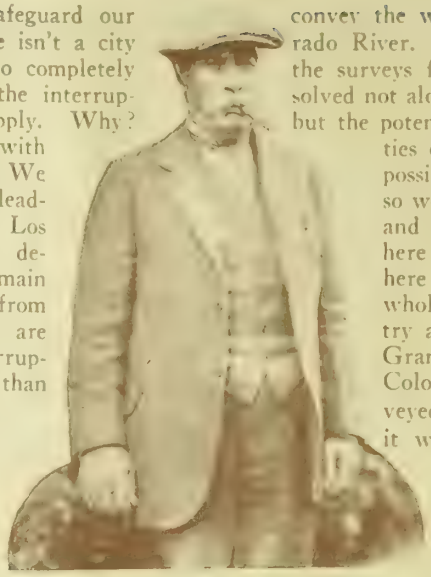
Mr. Mulholland's Model of the Proposed Boulder Canyon Dam to be Located at the Spot Pictured Above.

Angeles for twenty cents a hundred feet and I am certain we can, from the Colorado River by the building of the aqueduct that we now propose, we still will have cheaper water than the average large city in the United States.

Remember, other large cities that front on rivers or lakes have never had to worry about the water supply. The City of New York had the greatest problem and yet she never went more than 120 miles; and there were no mountains to climb; it all came by gravity. She is the only city that had any great water problem; the others just dipped their suction pipes into the rivers or lakes. You gentlemen have to contemplate in your everyday business, greater problems than any city in the East; you have a more expensive job before you.

Now the City of Los Angeles is peculiarly situated; a great area to the north of it, the San Fernando Valley, is very rapidly filling up. It was used as the dumping ground when the Owens River aqueduct was brought in; we didn't know what to do with the water pending its need for domestic use, and it was used there temporarily until we should know what to do with it. Population is increasing in the San Fernando Valley by leaps and bounds until it will be no time at all until that valley is densely settled. So we have built reservoirs on the margin of the Santa Monica mountains where we now have stored, free from any risk of interruption, these reserves. These reservoirs are very capacious; they have an average capacity of 30,000 acre feet and the mains run right into the city.

The City of Los Angeles has a waterworks that has a tremendous mileage of pipe; the people from the insurance companies used to come and wonder how we were going to safeguard our water supply. There isn't a city in America that is so completely safeguarded against the interruption of its water supply. Why? Because it was built with that end in view. We have thirteen mains leading into the City of Los Angeles; we do not depend on any one main carrying the water from a remote place; we are less exposed to interruption of water service than any city in America.



"I am not taking any particular credit for the Los Angeles water system. I have to thank my organization for that. I think, though, that it was the Koran or some other high religious authority that said: "He who bloweth not his own bassoon the same shall not be blown."

Praise Staff

I am not taking particular credit; I have to thank my organization for that. The thing seemed to be suggested naturally and it was so built. I think it is the Bible or the Koran or other high religious authority that said: "He who bloweth not his own bassoon the same shall not be blown."

This map, which I now present for your attention, is presumed to represent the new project of the City of Los Angeles. It embraces the territory lying between the Colorado River and the Pacific Ocean and southerly of the Boulder Canyon dam site. I point out here the Colorado River on its western boundary. As shown on this map, to the north and where the great bend on the Colorado River is situated is the Boulder Canyon Dam.

I have outlined here the ostensible first route surveyed for the aqueduct to convey the water from the Colorado River. Since we started on the surveys for this route we resolved not alone to survey that line but the potentialities and possibilities of other directions to possibly get a cheaper line, so we started broadcasting and within the boundary here shown clear up to here and taking in the whole Boulder Dam country and clear over to the Grand Canyon of the Colorado, we closely surveyed every bit of it and it will be shown in our complete topographical map.

Country Mapped

That whole country is worked out and a model relief map made of the whole area, so that we can go in front of that map and you can plot an existing route or any alternative route without leaving our office. Every bit of it has been traced mile by mile; we found out where tunnels have to go, where siphons have to go, where the ground is too high or too low. It is the most monumental piece of work ever constructed. It is now within a month of being completed.

I will say in regard to this route direct from Blythe to Los Angeles that it is the one that has the least tunneling; it is the one that comes out with the higher point of delivery. I will not deny the fact that I am in favor of that rõute; I don't like to boast about the discovery but if you turn a jackrabbit loose at the Colorado River there and scare him enough and headed him for Los Angeles he would go that route.

Curiously enough that route is almost to a mile the same length as the other big one we built, the Owens River aqueduct.

Now let's check up the cost of this thing. The Los Angeles aqueduct cost us a bond issue of $153.00 per capita; we had 160,000 people in the city at that time. Now that didn't scare the people; they went to the bat and they built the aqueduct and they got their benefit in the shape of billions of dollars in increased value to the real property alone, which paid for the aqueduct many times over.

That debt is a little over a third paid off, very nearly a half paid off now, and we are going to undertake another debt. The estimated cost in the rough is between 150 and 200 million dollars; it

(Continued on Page 33)

Here is the relief map referred to by Mr. Mulholland in the accompanying article. The San Bernardino mountains are in the foreground. The map covers approximately 35,000 square miles.

STORAGE & DISTRIBUTION

Corrosion Problems of a Water System and Methods of Protection

Determination of Corrosion Power of Certain Soils Is Big Job Confronting Waterworks Men

By E. B. STEWART

Electrolysis Engineer, East Bay Water Company, Oakland, California

Editor's Note: Mr. Stewart's paper—one of those read before the annual convention of the California Section of the American Water Works Association—will be published in two parts. Part I, in this issue, concerns soil corrosion. Part II, which discusses corrosion from externally applied electric currents, will appear in an early number.

THE subject of corrosion has not in the past been given the consideration the importance of the subject might warrant. The lack of interest is probably due to the fact that pipe systems are as a general rule looked upon as practically indestructible, and when once installed require no further attention or replacement. Experience has shown, however, that pipes are always subject to corrosion, and under certain conditions, serious damage occurs in a short period of time.

Many corrosion problems have simply been looked upon as unavoidable and repairs and replacements have been made without any effort to locate and remove the cause.

The subject of electrolysis will always be a pertinent subject as long as the running rails are used as a return path for the railway current. Improvement in rail bonding, the use of lager rails, and the more frequent distribution of substations, thereby reducing the distance that return current must travel on rails, have been of material aid in reducing this form of corrosion.

Theory of Corrosion

Before taking up methods of preventing corrosion, a brief explanation will be given of the manner in which corrosion takes place, for unless there is a fair conception of the fundamental factors influencing corrosion rates, it will be difficult to know what protective methods will be most suitable.

It has been conclusively shown that corrosion does not take place to any appreciable degree unless the metal be in contact with both water and free oxygen. The action is practically nil where the metal is in contact with oxygen alone, or oxygen free water alone. In other words, all three elements, namely, metal, water and free oxygen must be brought in contact to cause corrosion.

It has been shown that when iron is placed in water, a multitude of electric potentials are immediately established between the metal ions and the electrically charged ions in the water. These potentials cause metal ions to go into the solution and set hydrogen free. This hydrogen gathers on the surface of the iron in the form of a thin invisible film, and tends to retard the progress of corrosion by insulating the metal from the solution, and thus prevents further corrosion taking place. In order that corrosion may continue, the film of hydrogen must be removed. This may be accomplished by dissolved oxygen which is usually present in water combining with the hydrogen film to form water. The film having been removed, more iron can go into solution, more hydrogen can plate out and the process can continue at a rate determined by the speed with which the oxygen removes the hydrogen.

"Solution Pressure" Defined

The tendency of a metal to go into solution in a conducting liquid called the electrolyte is accompanied by an electrical potential between the metal and the solution. This potential is known as its "solution pressure" or "potential pressure" and is different for different metals in contact with the same solution and also different for different solutions in contact with the same metal.

Hence when two dissimilar metals are placed in a conducting liquid, a galvanic battery is formed and the difference in potential between the metals is proportional to the difference in their "potential pressures." When the metals are connected by wire, an electric current will flow through the wire between the metals, and the electropositive metal will corrode at a rate inversely proportional to the resistance of the circuit. Therefore, the rate of corrosion will be a maximum when the metals are brought in physical contact, which is usually the case in practice. In this case the circuit will be completed internally through the metals.

Corrosion resulting from contact of dissimilar metals is commonly called "galvanic action." This form of corrosion is often not generally understood, probably for the reason that it occurs under conditions that are difficult to study.

Corrosion in Practice

An example illustrating the effect of corrosion from this cause in practice is found in the destruction of our service pipes at the union connecting the lead goose neck. Many cases have been found where the service pipe shows general corrosion immediately adjacent to the union. The service pipe is the electropositive metal, hence a galvanic current will flow from the pipe to the union resulting in corrosion of the latter.

An insulating bushing placed between the pipe and the union was found to be the most economical method of preventing this type of galvanic corrosion. The electrical circuit is thus broken and the corrosion hazard is eliminated. This insulating medium also prevents the flow of stray railway currents.

There are many cases where it is impracticable to insulate dissimilar metals

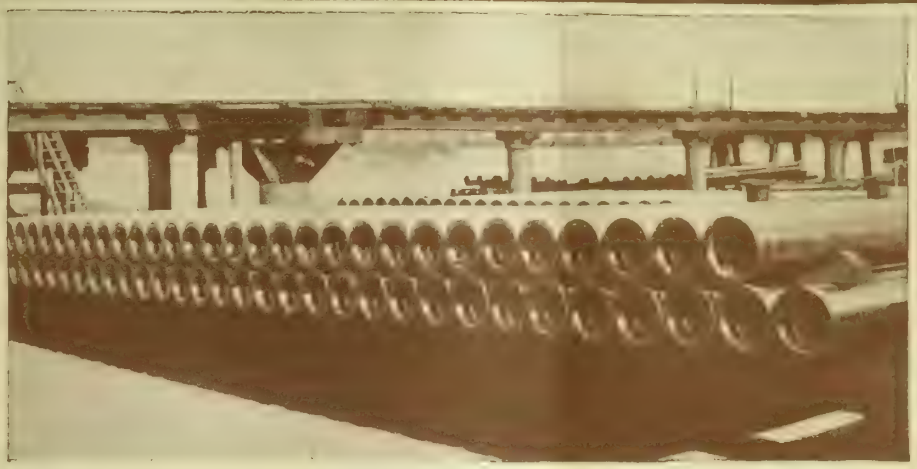
Preventive Measures

DAMAGE to pipes by soil corrosion may be prevented by two methods:

(1) Covering the pipe surfaces to insulate them from the earth.

(2) Making pipes negative to earth by external current or by the application of more anodic metals. This method is known as cathodic protection.

In the study of soils to determine the type of coating necessary to prevent soil corrosion, stray current from railway tracks should be taken into consideration. For instance, no coating is necessary on pipes located on railway lines where the potential of the pipes is negative to the rails regardless of the kind of soil, because it is well known that no corrosion takes place where pipes are negative to the earth. In some cases we have made small pipes negative to earth by connecting zinc plates to the pipe at intervals determined by earth current measurements. The plates are buried in the soil approximately one foot from the pipe. There is insufficient data available at present to determine the probable life of such protection, but from all indications, it appears to have some merit as a temporary expedient in localized cases.



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For Detailed Listings, Branch Offices, Etc., See the Buyers' Guide to Leading Supply Sources—Page 67

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from physical contact with each other, particularly in well pumping equipment. In this case, it is desirable to select materials that are most uniform in texture. In some cases where cost is an important factor and the extent of the corrosion is limited, it may be advisable to select such combinations of metals as to make the least expensive metal electropositive and the most expensive metal electronegative.

Soil Corrosion

Natural soil corrosion is sometimes spoken of as "self corrosion" to distinguish it from corrosion due to externally applied electric currents.

On the whole, corrosion in soils is similar to corrosion in water, because the controlling factor in soil corrosion is water. For in the absence of water, no corrosion will take place. But since pure water does not corrode iron appreciably, it is obvious that the corrosive character of the soil depends primarily upon the presence of certain dissolved materials in the soil water, which originate both from the air and from the ground.

In other words the soil is an electrolyte of widely varying concentrations due to the many factors present such as soluble salts, acids, dissolved gases, etc., which makes a solution of high electrical conductivity and hence more stimulating to corrosion than pure water.

Factors Affecting Corrosion

There are certain physical properties of pipes which have more or less influence on the corrosion rate, such as, character and uniformity of the surface finish of the metal, segregation of impurities in the metal, composition of the metal, area of the metal exposed as anode, parts of the metal that have been scratched or bruised from rolling, hammering or threading. Some of these factors influence the total amount of corrosion. For instance imperfections in mill scale will cause pitting which is the most destructive form of corrosion. It is well known that mill scale is electronegative to iron, and hence galvanic action takes place between them when in contact with a conducting solution.

It is obvious that differences of potential exist between the points on the pipe surface that are in contact with soils of different concentration, since it is known that the "potential pressure" of a metal is different for different solutions. It follows, therefore, that galvanic currents will flow through the pipe between different points of concentration on the pipe surface, entering the pipe at points of low concentration and leaving the pipe at points where current leaves the pipe.

That corrosion does occur in accordance with these conditions, has been verified by the writer by placing non-polarized electrodes about six inches apart at right angles to a steel pipe, and noting the difference of potential between them when one electrode is very close to the pipe. Two points were located three feet apart where current was flowing away from the pipe at one point and entering the pipe at the other. An examination of the pipe indicated that corrosion was in progress at the point where current was leaving the pipe, while the pipe was found in good condition where current was entering.

When Lines Run Parallel

This brings out the fact that corrosion is stimulated when parallel mains are laid in close association with each other for the reason that the pipes act as conductors to complete a galvanic circuit between points of different concentrations in the soil. To illustrate the effect of corrosion under these conditions, a steel pipe laid eighteen inches distant from a parallel sixteen-inch main that was abandoned, showed with an earth current meter a relatively large galvanic current leaving the pipe toward the abandoned pipe at a point where serious corrosion was in progress. When the abandoned pipe was removed, this point became negative to the earth, thus preventing further corrosion. We have found from earth current measurements that pipes laid parallel in the soil should be at least four feet apart in order to prevent the flow of destructive galvanic currents.

One of the outstanding problems that confront waterworks people, together with all other utilities owning underground pipes, is the development of improved means whereby the corrosive power of certain soils may be determined. For if it were possible to determine the corrosive power of the soil, it would be possible to determine what form of protection, if any, would be most suitable for a particular kind of pipe at a minimum cost. The present knowledge of the corrosiveness of any particular soil is based largely on practical experience of the corrosion of pipes in similar soils.

Tests Started in 1922

In 1922 the American Committee on Electrolysis and the National Bureau of Standards in cooperation with a number of pipe manufacturers buried thousands of small samples of different kinds of pipe in about forty locations widely distributed throughout the entire country, with a view of obtaining a further knowledge of the effects of different kinds of soil on the corrosion of buried pipes. All kinds of soil and climatic conditions have been included in the tests. It is the plan to submit tentative reports as fairly definite results develop. The whole investigation is being carried out by the Bureau of Standards and is being

watched with great interest by the manufacturers and users of pipe.

Our investigations of the corrosiveness of soils indicate that very little corrosion occurs in soils having a resistance over 100 ohms per cubic centimeter.

Preventive Measures

Damage to pipes by soil corrosion may be prevented by two methods:

(1) Covering the pipe surfaces to insulate them from the earth.

(2) Making pipes negative to earth by external current or by the application of more anodic metals. This method is known as cathodic protection.

In the study of soils to determine the type of coating necessary to prevent soil corrosion, stray current from railway tracks should be taken into consideration. For instance, no coating is necessary on pipes located on railway lines where the potential of the pipes is negative to the rails regardless of the kind of soil, because it is well known that no corrosion takes place where pipes are negative to the earth. In some cases we have made small pipes negative to earth by connecting zinc plates to the pipe at intervals determined by earth current measurements. The plates are buried in the soil approximately one foot from the pipe. There is insufficient data available at present to determine the probable life of such protection, but from all indications, it appears to have some merit as a temporary expedient in localized cases.

(End of Part I)

Colorado Aqueduct Will Cost Los Angeles Less Than Owens

(Continued from Page 29)

won't cost as much per capita as the Owens River aqueduct. The city is proportionately richer than she was then, so it is no great undertaking.

I reasoned these things out—soothed myself; I am itchy about it; I am afraid to talk about that much money; I was brought up by frugal people in Ireland and there wasn't that much money in all Ireland I am sure. At any rate it will be about that sum and I don't think the people need fear to incur that debt, nor do I believe the people here will have any such fears. The people in Los Angeles are a canny kind of folks, but where they can see a profit they are going to invest; you can depend on that.

Drop in at our office any time and you will really see what that Colorado River desert country looks like in the minutest detail from our relief map, every rabbit hole, trail, road, and hollow, will be shown there. This detail is going to be tremendously advantageous in laying out the aqueduct.

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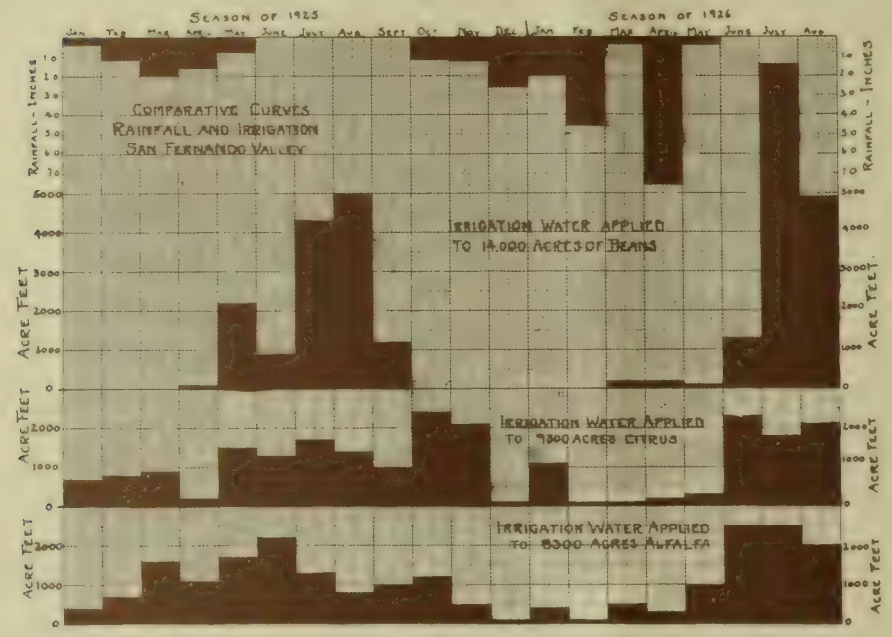
METERS & METERING

Read Issues Report for Los Angeles Meter and Service Department



Comparative curves, rainfall and irrigation water, San Fernando Valley

ACCORING to the annual report of George Read, superintendent, Meter and Service Department, Los Angeles Bureau of Water Works and Supply, the city water system had in service at the close of the fiscal year, June 30, 1926, a total of 218,635 meters as follows:

Meters in service, domestic and combination	211,231
Meters in service, intermittent irrigation	3,456
Jet meters in service, sewer flushing	3,948
Grand Total	218,635

The domestic and combination meters, according to size, were as follows:

⅝ in.	84,578
⅝x¾ in.	92,581
¾ in.	2,471
¾x1 in.	13,641
1 in.	10,003
1½ in.	4,509
2 in.	2,626
3 in.	474
4 in.	305
6 in.	43
8 in.	0

Total number domestic meters in service June 30, 1926	211,231
Number of meters in service July 1, 1925	197,476
Number of meters set during the year	13,755

Meter Failures

During the twelve months ending June 30, 1926, 22,534 meters were brought to the meter shop. Of this number, 14,823 were taken out because of failure to operate; 7,711 were taken out because of discontinuance or enlargement of the service on which they were set, or for minor repairs.

On an average for the year, 1235 meters were taken out monthly for failure to operate. The average percentage per month of the meters in service removed is .601, one meter for every 166 meters in service.

Table showing number of meters in service and percentages taken out monthly for failure to operate:

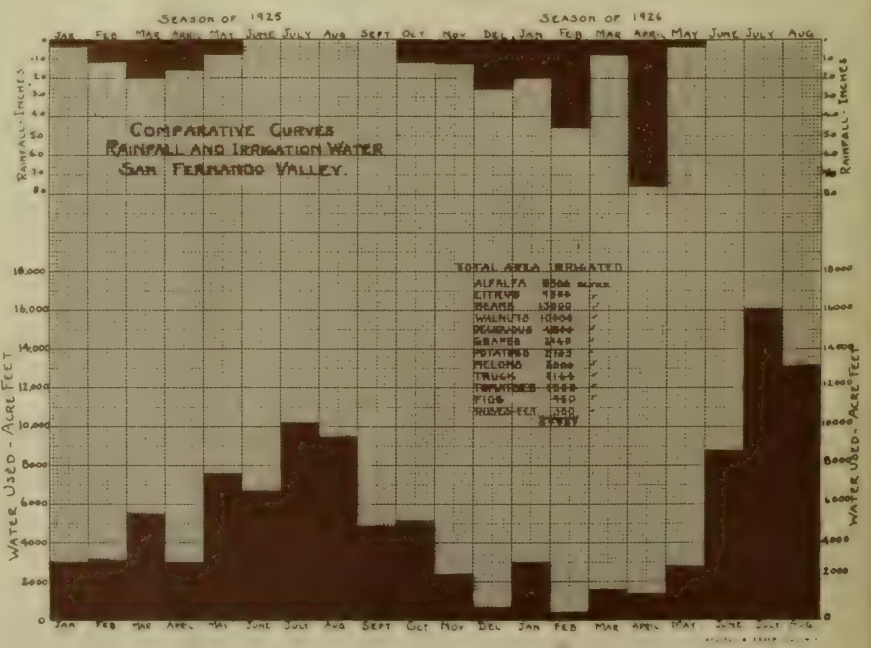
Meters in Service		Meters not Operating	% Taken Out
July, 1925	198,538	1,182	.6
Aug.	199,923	1,233	.62
Sept.	201,282	1,247	.62
Oct.	202,490	1,379	.68
Nov.	204,187	1,198	.59
Dec.	205,251	1,306	.64
Jan., 1926	206,308	1,077	.52
Feb.	207,220	1,254	.61
Mar.	208,446	1,335	.64
Apr.	209,536	1,150	.55
May	210,383	1,119	.53
June	211,231	1,343	.64

Average Upkeep 41 Cents

The average maintenance cost per meter, for all sizes in service, for the twelve months ending June 30, 1926, was 41 cents.

During the twelve months ending June 30, 1926, the department has changed 537 meters from straight to round reading meters. Most of these meters were taken over from privately owned water companies and are now being brought up to the standards of the department. Also, 6,761 meters were changed from open type gear trains to oil inclosed.

City officials of Burbank, California, are working on a comprehensive plan for the development of the local water system in connection with the expenditure of the bond issue of $150,000 recently voted.



Comparative curves, rainfall and irrigation water, San Fernando Valley

Beverly Hills Votes Water Bonds by Big Majority

Heavy Vote Polled; Will Spend Million Dollars for Improvement of Water System

The Beverly Hills, California, water bond issue, calling for one million dollars for the improvement of the local water system, was carried by a vote of 933 to 121 in a recent election.

Plans for a new filtration plant to cost $200,000, already practically designed, will be completed as the first expenditure to be made on the program of water improvement and the test work for the best type of coagulation for the filtration process will be proceeded with at once, according to Arthur Taylor, city consulting engineer.

The following is a summary of the various extensions and betterments for which the fund is proposed to be used and the estimated costs of same, as submitted by the city's firm of consulting engineers, Salisbury, Bradshaw and Taylor:

IMPROVEMENTS PROPOSED

Sherman Unit:	
Six new Sherman wells, pumping equipment, etc.	$ 44,000
Collection mains to Melrose and Sherman Ave., approximately 6000 feet, 8 to 16-inch	15,000
Pressure mains, Melrose and Sherman Ave., to Doheny or Sunset resvr. site, 5500 feet, 16-inch	23,000
Booster equipment and building	7,500
Possible aeration plant	25,000
Additional land for reservoir and reservoir at elevation of Reservoir No. 1	100,000
Miscl. pipe connections to east and west mains	7,500
Engineering and contingencies	28,000
Total	$ 250,000
Extension of Present System:	
Well sites, rights of way, litigation, etc.	$ 50,000
Two to four wells including pumping equipment, housing..$16,000 to	30,000
Collection mains 5,000 to	10,000
Booster pump and housing	6,000
Possible aeration	25,000
16-inch pipe line, booster site to southwest corner of city, 14,000 feet	42,000
300,000-gal. tower 55 ft. high and site	20,000
14-inch pipe line. Above tower to proposed new school site, 6500 ft., 14-inch, and site	40,000
Connections to east and west mains on Carmelita, Elevado and Lomitas	5,000
Engineering and contingencies	30,000
Total	$ 258,000
Water Treatment Plant:	
Additional land	60,000
5 M. G. D. filtration plant, including addition to aeration and plant to rid H2S gas	140,000
Experimentation	10,000
Engineering and contingencies	18,000
Total	$ 228,000

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WATER PUMPS

For Detailed Listings, Branch Offices, Etc., See the Buyers' Guide to Leading Supply Sources—Page 67

Other Additions and Betterments:	
Reservoir additions	$ 58,000
Completion of Franklin tunnel	6,000
New mains and replacements in present distribution	80,000
Systematic cleaning of all mains $10,000 to	20,000
Total	$ 164,000

Summary of Totals:	
Sherman Supply Unit	$ 250,000
Present System Extension	258,000
Water Treatment Plant	228,000
Other Additions and Betterments	164,000
Miscellaneous, Contingencies and Unforeseens	100,000
	$1,000,000

Report on Meter Maintenance Methods Gives Data on Current Practices

By J. H. FAGG

San Joaquin District Manager, Pacific Gas and Electric Company

FOR the purpose of this report a survey was made by means of a questionnaire returned by twenty-eight water companies in California, whose services were metered 80 per cent or over, and involving a total of approximately 640,000 services.

Of these twenty-eight, thirteen plants were municipally operated, and fifteen operated by private companies.

The questionnaire produced the following information:

(1) Fifteen companies check all new meters for accuracy upon receipt.

(2) Twenty companies use the round reading dials, and cubic foot, with one exception, is the unit of measurement.

(3) Only five are continuing the use of compound meters.

(4) Fifteen of the twenty-eight are using batteries of small meters on the larger services.

(5) But three of the companies test their meters periodically: one on two-year schedule, one on a 3-year schedule and one every 4 or 5 years. Also 2 remove their meters for test and overhauling after one complete revolution of the dial.

(6) Practically all of the companies use the concrete meter box and set meters just inside of curb line where mains are carried in the street.

(7) Eleven of those reporting are employing check valves to prevent hot water damage and bill consumers the cost of repairing the damage caused by hot water.

In analyzing the return on the questionnaire it appears that most of the companies realize the importance of testing new meters when received, and from the tone of some of the statements it is believed that it will soon be general practice to test all meters periodically.

The round reading registers are giving the best satisfaction as they will operate over longer periods than will the straight reader.

The use of compound meters is being discontinued rapidly by nearly all of the companies, and the use of batteries of small meters on large services is becoming popular with most Waterworks men.

A very small percentage of those reporting are making a practice of testing meters in the field, and they have equipped their shops with standard test tables of standard manufacture and other necessary facilities for proper handling of meter repairs.

Solving the Water Allocation Problem

(*Continued from Page 12*)

of irrigation benefits. With the total valuation on a basis, a tax rate is calculated to meet the budget with the legal required 15 per cent excess, and tax bills are prepared accordingly.

Naturally, some tax accrues unavoidably against "waived" lands but, with the nominal valuations set, it is trivial, and the general benefits easily compensate. As a practical convenience to the land owner the tax collector in preparing his tax bills shows the "waived" areas as a separate item with the corresponding tax.

To meet the water charges, which are not included in the budget, a *pro rata* flat charge per acre sufficient in the aggregate to meet the payment due to the San Diego County Water Company for the quota of water accruing during the following season, is made against each irrigable acre or lot; i. e., with "full water rights." Notice is given to the land owners by publication that this water toll may be paid in cash by a certain date, and if not so paid will be added to, and become a part of, the tax bill and a lien against the land. The practice is, as was expected, that these tolls are universally made a part of the tax bill and collected with the regular district taxes. Ample warrant for this procedure is contained in the statutes.

As heretofore stated, there is a 10 per cent annual step-up of water deliveries by the Water Company, so the district, therefore, tolls the land owner progressively for one-tenth of an acre-foot per year. For 1927, on the basis of 13,600 acre-feet originally purchased on graduated deliveries, the water allotment would be 2-10 acre-foot, which amount, on cost basis of $17.50 per acre-foot, would give a toll of $3.50 per acre. Since the district has acquired an additional thousand acre-feet, which is not on a graduated scale, but on a straight purchase basis, a *pro rata* of this amount has to be added to the quota stated, with a corresponding additional toll, giving a total water credit of 0.27 acre-feet and a charge of $4.50 per acre. The land owner then has a credit of 0.27 acre-foot of water to be used by him or not, as he sees fit. Eventually a plan will be formulated for the district to resell any unused water allotments to those requiring larger amounts, which will prevent the undesirable "peddling" of unused water. In case of a demand for it, the district may at any time procure from the water company additional water above the regular scheduled quota for that year up to the full contracted amount of 14,600 acre-feet.

Waived Areas Not Excluded

Although seemingly desirable at the outset, for obvious reasons it was found impractical to remove or exclude from the district these "waived areas," for if this had been done a "Swiss cheese" effect would have resulted. Being still legally within the district, these "waived" lands are not precluded from using water as would have been the case had they been removed, for the statute prohibits water deliveries outside an irrigation district. The district board now grants, on application, a permit for one-year periods to an owner of "waived" lands to use such water as he can spare from his fully watered lands, or that he may procure from non-users or surplus water of the district, and time is demonstrating that these areas will absorb considerable surplus and otherwise unused water until maturing orchards, etc., take up the full quota.

Furthermore, as development proceeds and lands are being more carefully examined, many acres of "declassed" lands are proving desirable for some particular use, and a marked tendency is already manifest toward a permanent transfer of water from less desirable fully watered tracts to these "waived" areas, which the board permits after careful scrutiny. The result is that an economic balance is evolving,—the water burden gradually shifting from lands that can not support the charges, to lands that are better suited to do so, due to the fact that there is an excess of lands competing for a fixed amount of water. The danger of the piling up of delinquent taxes on worthless or unused lands, which frequently proves serious and disastrous, will be avoided in the Vista Irrigation District under the play of economic forces afforded by this novel situation and its successful solution.

Current Meter Notes

Hydrometry has made little advance as compared with other branches of hydraulics, the reason for this, perhaps, being the difficulty of analyzing the forces that actuate current meters.

Smoothly flowing water can be measured by means of current meters with

a high degree of accuracy unless the velocity is too slow, but when the flow of a stream is turbulent to such a degree that it is difficult to hold a meter rigidly in the position least obstructing to stream flow—which is essential to reliable meter work—accurate measurements can not be expected.

All current meters will give coinciding results in smooth, evenly flowing water, when the relation between position of rotor axis and the direction of flow is definite and constant and the meter position is normal—the position which is maintained during calibration. Only under such conditions will results obtained by different types of meters or by different meters of the same type agree.

In reality, smoothly flowing water, where stream filaments move continuously parallel to each other, are rare if they exist at all. Although the appearance of the surface may indicate this condition, as a rule it will be found that below the surface the water is moving in varying directions. A meter can not respond to such forces in the same manner that it would to stream forces as they exist where water conditions are ideal, such as are artificially maintained at rating stations for the purpose of giving a meter its rating.

The question has been raised: Why not, then, rate the meters under conditions identical to those in which they will be used? The answer is simple,—there would be no base to the calibration unless a wide range of stream velocities were accurately preestablished.

It is natural that different types of current meters will be differently affected by forces of non-parallel stream lines. It is natural also that the makers of the different types of meters insist that their respective products are the most nearly perfect. The hydrographer will have to decide how a meter should be designed to meet best the prevailing conditions in order to produce most satisfactory results.

Since stream conditions as well as meter operations are never perfect, the solution of the meter problem will necessarily be a compromise. Nevertheless advantages and disadvantages in meters can be readily recognized when it is considered that the meter which offers least obstruction to the stream flow and at the same time is capable of a high rate of rotation, can not fail to be a reliable instrument. It is earnestly recommended that the meter's rating curve be examined in order to verify the good qualities which the appearance of a meter may suggest. A straight line curve of steep slope, connecting a large variety of rating points, is definite proof of quality.

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Fig. 200

Fig. 180

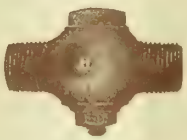

Fig. 40

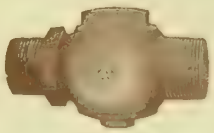

Fig. 41

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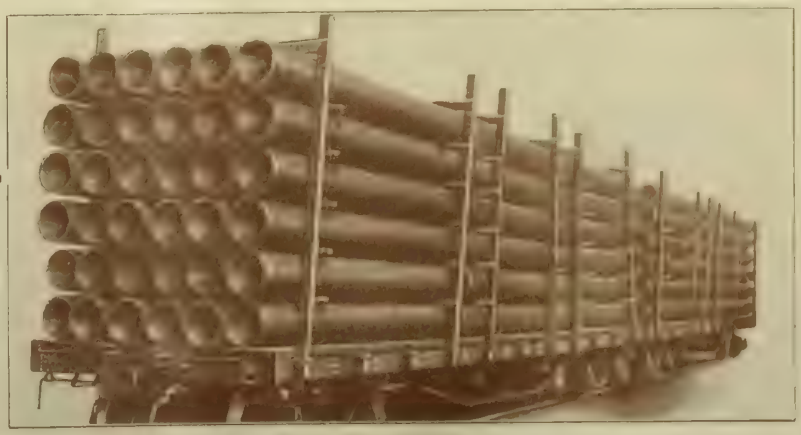

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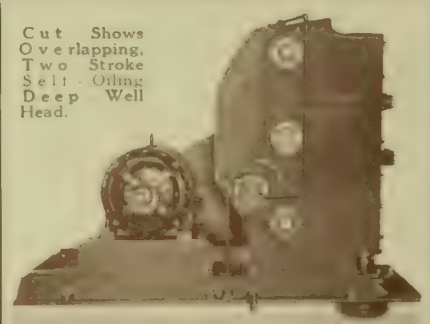

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Roll Call, Seventh Annual Convention American Water Works Association

California Section, San Diego, October 28, 29, 30, 1926

Name	City	Position
Abbott, C. B.	San Francisco	Pres. Waterworks Supply Co.
Abel, I. T.	San Gabriel	Mgr. San Gabriel Co. Water Dist.
Albin, W. W.	Altadena	Mgr. Rubio Con. L. & W. Co.
Allin, T. D.	Pasadena	Con. Engr. Allin Bros.
Anderson, L. M.	Los Angeles	Comptroller Dept. Water and Power
Armstrong, J. A.	Los Angeles	Dist. Sales Mgr. A. M. Byers Co.
Bachle, H. M.	Los Angeles	Worthington Co.
Bailey, George H.	San Francisco	Pacific Coast Mgr. National Meter Co.
Baker, R. H.	Los Angeles	Salesman Grinnell Co.
Barker, J. R.	San Francisco	Salesman Neptune Meter Co.
Barnum, F. K.	Fresno	Engr. Fresno City Water Co.
Bartlett, Max	Los Angeles	Burns-McDonnell-Smith Engr. Co.
Beck, George M.	Los Angeles	Chief Clerk Dept. Water & Power
Beeson, F. M.	Los Angeles	
Bell, Alexander	San Francisco	Pacific Coast Mgr. Wallace & Tiernan
Bergman, Chas. P.	San Francisco	San Francisco National Meter Co.
Best, E. C.	Los Angeles	California Filter Co.
Black, P. L.	Manhattan Beach	Supt. Water
Blair, W. R.	San Francisco	American Cast Iron Pipe Co.
Bovard, Paul F.	San Francisco	Asst. Mgr. California Filter Co.
Bowen, Edward R.	Los Angeles	Con. Engr. Reaburn & Bowen
Bowen, M. R.	Whittier	Supt. Water.
Bragg, George H.	San Francisco	Pacific Gas & Electric Co.
Brakenridge, C.	Vancouver, B. C.	City Engineer
Braslan, C. A.	San Francisco	Salesman, Neptune Meter Co.
Brooks, Frank M.	Pasadena	Art Concrete Works
Brooks, Harry L.	Pasadena	Art Concrete Works
Brooks, Louis	Pasadena	Art Concrete Works
Brown, Owen	Los Angeles	President Western Waterworks
Brown, W. C.	Cardiff	Supt. San Dieguito Irrigation District
Brownell, R. E.	Palos Verdes Est.	Gen. Mgr. Palos Verdes Water Co.
Browning, C. R.	Santa Ana	Manager and Engineer Irvine Co.
Burden, A. A.	Phoenix, Ariz.	Western Pipe & Steel Co.
Burdick, E. G.	Calexico	Commissioner Water and Light
Burk, W. H.	San Diego	Meter Repairman
Burroughs	San Francisco	Vice Pres. Ambursen Dam Co.
Burt, John	San Rafael	Gen. Mgr. Marin Municipal Water District
Burton, H. K.	Salt Lake City	Supt. Waterworks
Casad, Orla	Merced	Supt. City Water System
Case, Ha R.	Corona	Corona City Water Co.
Case, V. D.	San Francisco	Supt. Cement Gun Construction Co.
Cates, R. H.	Los Angeles	Power Engr. Southern California Edison Co.
Cates, W. H.	Los Angeles	Western Pipe & Steel Co.
Catey, S. F.	Los Angeles	Contracting Engineer
Chenoweth, L. A.	Los Angeles	Salesman Byron Jackson Pump Co.
Chamberlain, L. H.	Los Angeles	Waterworks Supply Co.
Champion, Frank	Laguna Beach	Mayor
Chase, Chas. H.	San Francisco	Sales Dept. Grinnell Co.
Claussen, C. G.	San Francisco	Pacific Coast Manager P. Nicoll & Co., Inc.
Clough, Frank H.	South Pasadena	City Engineer
Collins, W. H.	Los Angeles	Engr. Pacific Clay Products
Conner, W. S.	Los Angeles	B. Nicoll Co.
Conner, W. W.	Los Angeles	James Jones Brass Works
Cook, W. M.	Sherman	Supt. Sherman Water Co.
Corby, Frank F.	Los Angeles	Pac. Coast. Rep. A. M. Byers Co.
Corey, R. H.	Marshfield, Ore.	Mgr. Coos Bay Water Co.
Crooke, Arthur	Los Angeles	Worthington Meter Co.
Cundiff, Stuart A.	Newport Beach	Supt. Water & Sewer
Davis, Arthur P.	Oakland	Chief Engr. East Bay Mun. Utility District
Deal, H. B.	Pasadena	Supt. Lincoln Ave. Water Co.
Delafield, P. L.	Oakland	Salesman Grinnell Co.
Delaney, J. T.	Los Banos	Supt. City Waterworks
Dent, O. L.	Los Angeles	Salesman Parsons Co.
Derby, R. L.	Los Angeles	Con. Engr. Salisbury, Bradshaw & Taylor
DeRemer, E. L.	San Fernando	Supt. Water Dept.
DeWitt, Ward L.	Los Angeles	Salesman, Mueller Co.
Dickinson, H. L.	Los Angeles	Pac. Coast Mgr. Chapman Valve Mfg. Co.
Diederich, Peter	Glendale	Supt. Water & Light
Diehl, Paul A.	Los Angeles	Con. Engr. Black & Veatch
Dodge, F. L.	Los Angeles	Asst. Mgr. Belvedere Water Corp.
Downer, T. B.	Alhambra	Chief Engineer and Superintendent
Dudley, H. M.	Los Angeles	Sales Mgr. McWane Cast Iron Co.
Dussell, H. L.	San Diego	Western Metal Supply Co.
Edgcumbe, A. E.	Vallejo	City Clerk
Edgington, Carl E.	San Diego	National Iron Works
Egan, J. H.	Los Angeles	Salesman Crane Co.
Ehle, C. G.	Portland, Ore.	Asst. Engr. Water Bureau
Ellen, H. J.	Berkeley	Asst. Mgr. Byron Jackson Pump Co.
Elsener, L. A.	San Francisco	Chicago Bridge & Iron Works
Everett, E. E.	Ventura	Hydraulic Engineer
Farmer, O. O.	Inglewood	Consulting Engineer
Farrell, Louis	Oakland	Superintendent
Feeny, J. F.	San Diego	Western Metal Supply Co.
Ferem, W.	Los Angeles	Hill, Hubbell & Co.
Finkle, F. C.	Los Angeles	Con. Hydraulic Engr.
Forni, G.	Emeryville	Forni Mfg. Co.
Forni, N.	Emeryville	Forni Mfg. Co.
Foster, Wm. S.	San Francisco	M. Greenberg's Sons
Freeman, V. M.	Santa Paula	Mgr. Waterworks
French, H. W.	San Francisco	Hill, Hubbell & Co.
Frick, A. L.	Los Angeles	Engr. Wallace Tiernan Co.
Gerhart, Robert W.	San Francisco	Engr. Beargulch Water Co.
Giacomazzi, P. A.	Santa Paula	Superintendent Waterworks
Gill, R. F.	Yucaipa	Superintendent Water Co.
Gillespie, Chester G.	Berkeley	State Sanitary Engineer
Gillette, W. M.	Fullerton	Water Superintendent
Gilman, H. S.	San Dimas	Superintendent Water Co.
Given, C. W.	Monrovia	Water Superintendent
Goble, W. F.	Alhambra	Supt. San Gabriel Valley Water Co.

For Detailed Listings, Branch Offices, Etc., See the Buyers' Guide to Leading Supply Sources—Page 67

Name	City	Position
Goudey, R. F.	Los Angeles	Res. Enginr. State Board of Health
Graff, Hans	San Francisco	Jr. Engr. U. S. A. Engineers
Gray, Scott C.	Los Angeles	Salesman Worthington Meters
Green, E. W.	San Jose	Purchasing Agt. Waterworks
Greenberg, Stuart N.	San Francisco	M. Greenberg's Sons
Gwynn, E. K.	Salinas	Coast Valley Gas & Electric Co.
Haigh, J. K.	Los Angeles	Asst. Sales Mgr. Frank J. Kimball Co.
Haller, K. F.	Los Angeles	Salesman R. W. Sparling Co.
Hannum, V. W.	Anaheim	Supt. Light & Water Department
Harlan, G. H.	Sausalito	Attorney
Harmon, Burt	Long Beach	Water Department
Hatch, F. W.	San Francisco	Pittsburgh-Des Moines Steel Co.
Hausman, A. R.	San Francisco	U. S. Cast Iron Pipe & Foundry Co.
Henkenius, F. J.	San Francisco	Mgr. S. F. Kennedy Valve Co.
Hendershot, B. L.	Los Angeles	National Cast Iron Pipe Co.
Henderson, Tom	Sierra Madre	Superintendent Water Department
Hinckely, G. S.	Redlands	City Engineer
Howard, James B.	Earlimart	President Water Co.
Hughes, Fred M.	Los Angeles	Asst. Cashier and Managr Ind. Office
Hurlbut, Wm. W.	Los Angeles	Office Engr. Water Dept.
Hutchins, R. T.	El Segundo	Superintendent Water Department
Irvine, M. H.	Alhambra	City Manager
Isaac, F. N.	Hanford	Mgr. Hanford Meter Co.
Jack, Allen	San Francisco	Hersey Mfg. Co.
Jackson, C. B.	Fresno	General Maanager
James, J. C.	South Pasadena	Superintendent Water
Jameson, Capt. W.	Flintridge	Superintendent Water Co.
Jay, Samuel	Los Angeles	Pres. United Casting Co.
Jett, Bill	Los Angeles	Mgr. Mueller Co.
Jewett, R. P.	San Diego	Salesman Western Metal Supply
Johns, H. M.	Hanford	Superintendent Water Co.
Johnston, C. H.	Los Angeles	DeLaval Steam Turbine Co.
Jones, Morris S.	Pasadena	Asst. Engr. Water Department
Jones, Walter	Los Angeles	James-Jones Co.
Jorgenson, H. A.	San Bruno	Superintendent
Kells, Thomas J.	San Francisco	Salesman Neptune Meter Co.
Keller, George D.	Los Angeles	Engineer
Kent, A. L.	Los Angeles	Secy.-Treas. Imperial Utilities Corp.
Kilbourne, M. L.	Los Angeles	Wailes-Dove-Hermiston Corp.
Kimball, C. L.	Beverly Hills	Superintendent Water Department
Kimball, Frank J.	Los Angeles	Frank J. Kimball Co.
King, W. L.	Los Angeles	Salesman, Hersey Mfg. Co.
Kittredge, H. S.	San Jose	Secy. San Jose Waterworks
Koster, R. F.	Los Angeles	Sales Engr. Western Pipe & Steel Co.
Lacy, Richard W.	Los Angeles	Engr. Lacy Mfg. Co.
Langlier, W. F.	Berkeley	Prof. Sanitary Engr. U. C.
Launer, N. M.	La Habra	Supt. La Habra Domestic Water Co.
Leary, Thos. F.	San Francisco	Mgr. Pacific Coast Branch Mueller Co.
Leavitt, W. F.	Fresno	Superintendent Water Co.
Lee, Chas. H.	San Francisco	Consulting Engineer
Lewis, J. E.	Fullerton	Supt. Yorba Linda Water Co.
Lockwood, F. L.	San Diego	Hose & Lockwood
Longland, E. L.	San Rafael	Supt. Marin Mun. Water Dist.
Longley, Francis B.	San Francisco	Hill, Hubbell & Co.
Lovell, A. P.	San Diego	Superintendent Water
Luippold, G. T.	Los Angeles	Mgr. L. A. Office Wallace & Tiernan Co.
Lundy, E. W.	Stockton	Salesman Sterling Pump Co.
Lundy, J. E.	Stockton	Manager Sterling Pump Co.
MacKall, M. R.	San Francisco	Hydraulic Engr. State Railroad Commission
Magary, O. J.	Los Angeles	Civil Engr. Chapman Valve Mfg. Co.
Magerstadt, P. E.	Oakland	Assistant Chief Engineer
Manley, R. G.	Upland	Superintendent Water
Manock, Foster	Los Angeles	Waterworks Supply Co.
Markley, C. P.	San Francisco	DeLaval Steam Turbine Co.
Marks, Samuel M.	Oakland	Secy.-Treas. East Bay Water Co.
Marron, J. E.	Los Angeles	Salesman U. S. Steel Products Co.
Martindale, R. W.	San Francisco	Sales Manager U. S. Cast Iron Pipe Co.
May, H. B.	San Diego	General Electric Co.
McBride, W. Z.	Vacaville	Mgr. Vacaville Water & Power Co.
McCambridge, G. H.	Burbank	Superintendent Public Utilities
McFarland, D. S.	Los Angeles	Neptune Meter Co.
McKibbin, Robert H.	El Centro	Supt. Water, Sewer & Park
McLaren, Peter	Whittier	Hydraulic Engineer
Means, B. I.	Los Angeles	Burns-McDonnell-Smith Engr. Co.
Mercer, C. T.	Los Angeles	Western Waterworks
Meskimons, C. B.	Los Angeles	Philbrook Spring Pipe Clamp Co.
Mills, W. C.	San Francisco	Sales Mgr. General Chemical Co.
Milton, R. S.	Los Angeles	International Filter Co.
Miracle, W. D.	San Francisco	Bunkerhill Smelter Co. & Northwest Lead Co.
Mohr, Jack	Huntington Park	Superintendent Water
Moore, I. E.	Los Angeles	Dept. Mgr. Fairbanks Morse Co.
Moore, Leo G.	San Diego	Mg. National Iron Works
Morris, Samuel B.	Pasadena	Superintendent and Chief Engineer
Morse, Chas. H.	Altadena	Pres. Las Flores Water Co.
Mosher, F. A.	Los Angeles	Western Waterworks
Mudge, J. R.	Los Angeles	
Mulholland, Wm.	Los Angeles	Chief Engineer
Munson, C. H.	Los Angeles	Asst. Mgr. L. A. Water Service Co.
Newton, Lucian C.	Los Angeles	Secy.-Treas. United Casting Co.
Noble, W. A. E.	Los Angeles	United Casting Co.
Northrop, L. E.	Los Angeles	Neptune Meter Co.
Nye, Allen H.	Los Angeles	Neptune Meter Co.
Oberholtzer, D. A.	Monterey Park	Superintendent Water Department
Ogburn, Chas.	San Diego	Torrey Pines Pumping Station
Oliver, Graydon	Los Angeles	Tech. Editor Modern Irrigation & Western Waterworks
Olmsteade, C. S.	Del Monte	Superintendent Water
Orton, Edgar	Ventura	Superintendent Water
Ozmun, C. A.	San Diego	National Iron Works
Page, A. L.	Los Angeles	Gen. Mgr. Belvedere Water Corp.
Pedder, Wilmer W.	Los Angeles	Pres. Conservative Water Co.
Perhab, John L.	Calexico	Superintendent Water
Peters, J. S.	San Rafael	Engr. Marin Water District
Phelps, E. W.	Alhambra	Supt. Const. Water Co.
Phillips, J. E.	Los Angeles	Asst. Engr. Water Dept.
Piersol, G. T.	San Francisco	American Brass Co.
Plageman, R. D.	San Francisco	Sales Mgr. Western Pipe & Steel

(Continued on Page 42)

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WATER PURIFICATION

Water Improvement Lies in the Study of Biological Control of Reservoirs

Amount of Work Done by Living Plants and Animals is Astonishingly Great in the West

By DR. CARL WILSON

Director of Biological Laboratory, Los Angeles Bureau of Waterworks and Supply

WHETHER he anticipates it or not, the engineer who constructs an impounding reservoir for domestic supply is confronted with a problem, or rather, an unending variety of problems, in economic biology. The idea that he is dealing only with engineering structures and a chemical called in common language "water," was shattered years ago, but it is only recently that the waterworks superintendent seriously attacked the living causes of his troubles on the one hand, or encouraged his aquatic friends on the other.

Rarely does a water consumer have any conception of the important part which living organisms play in the quality and safety of the water which he uses so freely. He has a vague, and often erroneous, idea that running water purifies itself, and he is aware that disease may be caused by polluted water, but he is not likely to realize that both effects are due to living things. The observing housewife whose kitchen tap brings her water which has passed through one or more large reservoirs, may have noticed that the water is softer at the end of summer than it was in spring, but she would never guess that this difference is due to the untiring activities of microscopic plants. The waterworks engneer who is troubled with evil smelling and testing water, or who is tormented by hordes of insects in his lakes, knows only too well how important is a knowledge of biology.

West's Varied Problems

In our semi-arid climate, where we are compelled to store immense volumes of water for long periods, and where we have the maximum amount of sunshine, with accompanying high water temperatures, biological problems are not only more varied than in the East, but also more intense and trying. Even the stratification of water in a large storage reservoir, due to temperature differences between the top and bottom waters is more pronounced here, because reservoirs often received no influx of new water for months at a time. All summer long and far toward winter, the surface layer of the water will be enough warmer than the rest to prevent mixing with water lower down unless wind and wave action should be unusually effective.

RARELY, points out Dr. Wilson, does a water consumer have any conception of the important part which living organisms play in the quality and safety of the water which he uses so freely. He has a vague and often erroneous idea that running water purifies itself, and he is aware that disease may be caused by polluted water, but he is not likely to realize that both effects are due to living things. The observing housewife whose kitchen tap brings her water which has passed through one or more reservoirs, may have noticed that the water is softer at the end of the summer than it was in spring, but she would never guess that this difference is due to the untiring activities of microscopic plants. The waterworks engineer who is troubled with evil smelling and tasting water, or who is tormented by hordes of insects in his lake, known only too well how important is a knowledge of biology.

As a result of this condition, bacterial activity on the organic matter present in the water and in the bottom ooze, quickly absorbs all the free dissolved oxygen, and further bacterial activity must necessarily be of an anaerobic type, with the inevitable production of foul smelling decomposition products which are characteristic of stagnant water. Generally, hydrogen sulphide is one of these products.

We are told that the thermocline, or line of separation between the deeper, colder, stagnant water, and the upper, warmer, layer of aerated water, lies at a depth of 30 to 35 feet, but in most of our Southern California reservoirs it is likely to be much nearer the top, while in at least one lake with which the writer is familiar it is frequently only ten feet below the surface.

Since the production of objectionable odors in this case is wholly the result of living organisms, the solution of the problem must be a biological one. The answer is, furnish enough oxygen to make anaerobic activity impossible, as bacterial by-products produced in the presence of sufficient oxygen are relatively inoffensive. Complete control of this condition has been obtained in the Lower Franklin Reservoir, on the Los Angeles aqueduct system, by introducing the inflowing water through a pipe lying on the bottom of the lake, and extending from the upper end to within a short distance from the outlet tower. About every 100 feet along this pipe 4-inch openings are provided which shoot jets of water upward, and these jets not only bring to the bottom of the lake a supply of water which is saturated with oxygen, but they also keep the entire body of water in a constant state of circulation. Stagnation never occurs in this lake, and water from the bottom is always as sweet as that at the top.

Lower Franklin reservoir is about a mile long, very narrow, and some 70 feet deep at the dam. Because of its shape, this method of providing circulation is especially effective. The same procedure in Stone Canyon reservoir, which reaches a depth of nearly 200 feet at maximum, is successful, but not to the same degree as at Franklin, due to the greater width and the presence of two large arms which cannot be reached by the pipe system as installed.

Plankton Growths

Plankton growths in reservoirs afford an outstanding example of the need for control measures, and the methods adopted for their repression are familiar to waterworks men, as they are almost universally practiced upon open reservoirs. Sometimes, however, algae may be useful, and the destruction of such a growth is not always advisable.

On the Los Angeles system we have a reservoir covering an area of about 100 acres, with a maximum depth of 45 feet, and impounding 700,000,000 gallons, which illustrates the point. Three years ago this lake was drawn down to a small pond of about five acres extent, in order to make some changes in the outlet, and the exposed bottom ooze gave off sufficient odor to cause complaints from some of the nearby residents. To satisfy these people the lake bottom was plowed over and fresh, clean earth turned over the ooze, making virtually a new bottom for the reservoir.

(Continued on Page 48)

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Waterworks Convention Roll Call

(Continued from Page 39)

Name	City	Position
Porter, S. J.	San Francisco	Wailes-Dove-Hermiston Corp.
Posey, Geo. W.	San Francisco	Supt. Spring Valley Water Co.
Prentice, E. R.	San Rafael	Secy. Marin Municipal Water Dist.
Prugh, J. I.	Sacramento	Superintendent Water
Rainey, C. M.	Pocatello, Idaho	Superintendent Water
Randlett, F. M.	San Francisco	Robt W. Hunt Co.
Reed, Geo.	Los Angeles	Supt. Meter & Service
Reeder, G. J.	Los Angeles	So. Cal. Rep. Kennedy Valve Mfg. Co.
Reinhardt, Harry	Oakland	Asst. to Gen. Mgr. East Bay Water Co.
Reineke, E. A.	Berkeley	Asst. State Sanitary Engr.
Rice, P. D.	Redondo Beach	Supt. Hermosa-Redondo Water Co.
Richardson, W. J.	Orange	City Water Superintendent
Rick, Edw. L.	Los Angeles	Pres. Rick Co.
Rider, E. L.	Montrose	Supt. Crescent Mutual Water Co.
Ringel, W. J.	Pasadena	Asst. Supt. Water Department
Robinson, Francis J.	San Mateo	Asst. Mgr. Peninsula Water Co.
Robinson, M. A.	Ventura	Asst. Supt. Water Department
Roen, Otto S.	Ontario	City Service Manager
Rohl, H. W.	San Francisco	Contractor
Rowe, E. A.	Los Angeles	Chief Engr. J. B. Lippincott & Co.
Rutledge, E. A.	Los Angeles	Salesman Waterworks Supply Co.
Safford, L. A.	Los Angeles	Dist. Mgr. DeLaval Steam Turbine Co.
Schuck, H. W.	Burlingame	Superintendent Waterworks
Schuyler, Philip	San Francisco	Editor Western Construction News
Scott, W. A.	Riverside	Superintendent Waterworks
Sedgwick, C. E.	Dixon	Dist. Mgr. Pac. Gas & Elect. Co.
Shaw, Clark H.	Long Beach	Chief Engineer Water Dept.
Shibley, Kenneth	Seattle	Shibley & Bovard, Engr.
Shumaker, Ted	San Francisco	Salesman Worthington Meter Co.
Shrode, F. M.	Long Beach	Supt. Const. Water Dept.
Sibbett, Geo. E.	Proro, Utah	Pac. States Cast Pipe Co.
Sibley, J. T.	Los Angeles	Water Department
Small, Sidney S.	Los Angeles	National Meter Co.
Smalley, J. D.	Hayward	Superintendent
Smock, H. G.	Los Angeles	Dearborn Chemical Co.
Snodgrass, H. H.	Covina	Superintendent Water
Snodgrass, H. V.	Los Angeles	R. W. Sparling Mfg. Co.
Sparling, R. W.	Los Angeles	R. W. Sparling Mfg. Co.
Stanford, W. B.	Los Angeles	Western Pipe & Steel Co.
Starke, Wm.	San Bernardino	Superintendent Water Dept.
Stava, William	San Francisco	Asst. Engr. Railroad Commission
Stead, A. J.	Los Angeles	Asst. Engr. J. B. Lippincott & Co.
Stephens, C. D.	La Habra	Assistant Manager
Stephens, Walter W.	Santa Monica	Superintendent Water
Stevenson, Ralph A.	Sacramento	Supt. Filtration Plant
Stromsoe, D. A.	Los Angeles	Baker Iron Works
Strout, Dale S.	San Francisco	International Filter Co.
Sumner, R. S.	Denver, Colo.	Gen. Mgr. Northern Colorado Irrigation Co.
Swenson, J. J.	Los Angeles	American Cast Iron Pipe Co.
Symonds, Harry C.	Mill Valley	Pres. Marin Municipal Water Co.
Thiess, Robert H.	Los Angeles	Western Waterworks
Thomsen, F.	Los Angeles	Salesman United Casting Co.
Timanus, C. S.	Los Angeles	Burns-McDonald-Smith Co.
Tomlinson, O. N.	Redondo Beach	Mgr. Hermosa-Redondo Water Co.
Trauger, Geo. W.	Lindsay	Supt. Lindsay-Strathmore Irrigation District
Tulloch, T. H.	San Diego	Water Department
Van Kennen, H. H.	Los Angeles	Mechanical Engineer
Van Vechten, A.	San Francisco	Mgr. No. Calif. McWane Cast Iron Pipe Co.
Wade, S. H.	San Francisco	Pres.-Gen. Mgr. Western Construction News
Walz, Chester D.	Los Angeles	Engr. C. W. Sirch. Mfgs.
Walter, H. A.	Los Angeles	Salesman Western Pipe & Steel
Ward, R. V.	Upland	Water Company
Watkins, Harry	Los Angeles	Layne & Bowler Pump Co.
Webster, Fred D.	San Francisco	Salesman National Meter Co.
Westaway	Montecito	Superintendent Construction
Whitacre, R. D.	Tucson, Ariz.	Superintendent Water Dept.
Whitaker, Otto C.	Los Angeles	Chief Meter Reader
Wilber, G. O.	Glendale	Superintendent Construction
Williams, G. P.	Los Angeles	National Cast Iron Pipe Co.
Wilson, Dr. Carl	Los Angeles	Bacteriologist
Wray, Walter	Santa Ana	Superintendent Water
Wueste, R. C.	San Diego	Supervisor Water Impounding
Wyatt, B. W.	Los Angeles	Engineer of Sewers

Name	City	Name	City
Abel, Mrs. J. T.	San Gabriel	Feeny, Mrs. J. F.	San Diego
Albin, W. W.	Altadena	Frick, Mrs. A. L.	Los Angeles
Allin, Mrs. T. D.	Pasadena	Name	City
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Bell, Mrs. Alexander	San Francisco	Goble, W. F.	Alhambra
Bird Mrs.	Los Angeles	Grey, Miss	Corona
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Blair, Mrs. W. R.	San Francisco	Harmon, Mrs. Burt	Long Beach
Bowen, Mrs. M. R.	Whittier	Harless, Mrs.	Los Angeles
Brooks, Mrs. Frank M.	Pasadena	Howard, Mrs. J. B.	Earlimart
Brown, Mrs. W. C.	Cardiff	Hurlbut, Mrs. W. W.	Los Angeles
Burdick, Mrs. E. G.	Calexico	Irvine, Mrs. M. H.	Alhambra
Burt, Mrs. John	San Rafael	Isaac, Mrs. F. N.	Hanford
Barnes, Miss	Corona	Jewett, Mrs. R. P.	San Diego
Cates, Mrs. R. H.	Los Angeles	Johns, Mrs. H. M.	Hanford
Cates, Mrs. W. H.	Los Angeles	Jones, Mrs. M. S.	Pasadena
Conner, Mrs. W. S.	Los Angeles	Kent, Mrs. A. L.	Los Angeles
Cook, Mrs. W. M.	Stockton	Kimball, Mrs. C. L.	Beverly Hills
Cundiff, Mrs. Eva	Newport Beach	Launer, Mrs. N. M.	La Habra
Cundiff, Mrs. Delphian	Newport Beach	Longland, Mrs. E. L.	San Rafael
Davis, Mrs. A. P.	Oakland	Longley, Mrs. F. B	San Francisco
Deal, Miss	Pasadena	Luippeld, Mrs. G. T.	Los Angeles
Delafield, Mrs. P. L.	Oakland	Manley, Mrs. R. G.	Upland
Derby, Mrs. R. L.	Los Angeles	Markley, Mrs. C. P.	San Francisco
Diederich, Mrs. P.	Glendale	McCambridge, Mrs. G. H.	Burbank
Dolan, Miss Eva	Huntington Park	McKibbin, Mrs. R. H.	El Centro
Dudley, Mrs. H. M.	Los Angeles	Merrill, Mrs.	Long Beach
Egan, Mrs. J. H.	Los Angeles	Meskimons, Mrs. C. B.	Los Angeles
Elsener, Mrs. L. A.	San Francisco		
Everett, Mrs. E. E.	Ventura		

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Miracle, Mrs. W. D.	San Francisco
Mohr, Mrs. Jack	Huntington Park
Moore, Mrs. L. G.	San Diego
Mudge, Mrs. J. R.	Los Angeles
Munson, Mrs. C. H.	Los Angeles
Munson, Mrs. J. L.	Los Angeles
Nye, Mrs. Allen H.	Los Angeles
Oberholtzer, Mrs. D. A.	Monterey Park
Pedder, Mrs. W. W.	Los Angeles
Perkins, Miss M. S.	Pasadena
Peters, Mrs. J. S.	San Rafael
Phillips, Mrs.	Long Beach
Pracy, Mrs. G. W.	San Francisco
Prentice, Mrs. E. R.	San Rafael
Read, Mrs. Geo.	Los Angeles
Rice, Mrs. P. D.	Redondo Beach
Richardson, Mrs. W. J.	Orange
Rick, Mrs. E. L.	Los Angeles
Ritzel, Mrs. W. J.	Pasadena
Sedgwick, Mrs. C. E.	Dixon
Shaw, Mrs. C. H.	Long Beach
Smalley, Mrs. J. D.	Hayward
Stephens, Mrs. C. D.	Whittier
Stromsoe, Mrs. D. A.	Los Angeles
Swenson, Mrs. J. J.	Los Angeles
Symonds, Mrs. H. C.	Mill Valley

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Trauger, Mrs. G. W.	Lindsay
Walz, Mrs. C. D.	Los Angeles
Watkins, Mrs. Harry	Los Angeles
Westawat, Mrs. R. P.	Montecito
Wilson, Mrs. Carl	Los Angeles

Postpone Water Case Hearing

Final allotment of water from the San Jacinto River, California, has been postponed until May 10 next, in accordance with the request of two of the interested companies. The application for a postponement was made by the Lake Hemet Water Company and the Fruitvale Mutual Water Company which are to be merged into one, the Hemet San Jacino Water Company. It was because of this merger that the delay was asked, according to W. H. Pawson, official of the new company. Two years ago conflicting claims to the water flowing in the San Jacinto River led to an extensive investigation by engineers under the direction of Edward W. Hyatt, chief of the division of water rights. With the results of the survey, Hyatt made a tentative allotment of water to five separate concerns with the understanding that this apportionment was subject to change. Controversy among the companies centers largely around the disposition of a relatively small portion of the water that at present is not being used, according to Hyatt.

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SEWAGE DISPOSAL

Chicago Has Biggest Sewage Treatment Problem of Any U. S. City

CHICAGO is confronted with a larger sewage treatment problem than any other city in the United States. Probably few even of its own citizens realize the extent of the work which has been done, is being done, and is contemplated as one of the future necessities. The sewerage of the city and immediate vicinity is in charge of a board of trustees of a district known as the Sanitary District of Chicago, which board raises its own funds for meeting the necessary expenses by taxation.

In 1925, the United States Supreme Court decided that it rested with the Secretary of War to control the amount of water which could be withdrawn by the sanitary district from Lake Michigan for diluting the sewage in the drainage canal, and the Secretary granted a five-year permit for withdrawing 8,500 cubic feet per second, conditioned upon the performance by the district and the city of Chicago of certain obligations, of which the most important were the vigorous prosecution of a program for artificial sewage treatment, the metering of the Chicago water supply, and the construction of flood control gates in the Chicago River.

Comprehensive Plan

In 1923, the Illinois legislature amended the enabling act of the Sanitary District and required that sewage treatment works be put in operation annually, beginning with 1925, at the rate of 300,000 persons per year until provisions had been made for approximately 1,800,000 population. The requirements connected with the permit issued in 1925 by the Secretary of War imposed additional requirements and a program was prepared in five-year periods looking toward the ultimate completion of a system of intercepting sewers, pumping stations and treatment works whereby all the suspended solids will be removed and the liquid pollution so reduced biologically that the main channel and Illinois river will be cleaned up.

In July, 1925, the Illinois state legislature granted the district 1 per cent additional bonding power for the specific purpose of construction of sewage treatment works and adjuncts and for settlement of Illinois valley overflow claims. The district shortly thereafter submitted to the United States engineer a definite construction program calculated to fulfill the requirements of the permit, which was approved on July 28, 1926. During the year the district completed work amounting to approximately fourteen million dollars, and during the last half of the year awarded contracts totaling over eight million dollars.

Big Sums Involved

A bald list of the work under contract and which should be started in the near future occupies 3 1-2 printed pages. Some of the more important items are as follows: Under Contract—North side intercepting sewer, $1,799,000; north side sewage treatment works, $4,005,000. Completion of projects under way—North branch pumping station, $3,000,000; Calumet sewage treatment works additions, $3,693,000; north side sewage treatment works, $3,530,000.

Work which has not yet been started but should be begun this year includes the west side intercepting sewer, $15,800,000; Salt Creek intercepting sewer, $1,500,000; Oak Forest outlet sewer, $600,000; industrial wastes intercepting sewer, $850,000; west side treatment works, $13,410,000; southwest side sewage treatment site, $500,000.

There will be needed in the future although not immediately, a Racine Avenue pumping station, $3,000,000; southwest side intercepting sewer, $8,800,000; southwest side sewage treatment works, $7,200,000; north shore intercepting sewer extensions, $1,000,000; power service for north side sewage treatment works, $5,000,000, and various other items of under one million dollars each.

Engineer Reports on Progress

In reporting on this work the chief engineer, E. J. Kelly, describes briefly the condition of each of the various projects on January 1, 1926. The Calumet intercepting sewer system is practically completed and is receiving all the dry weather flow from the territory served. The North side intercepting sewer, the main feeder to the north side sewage treatment works, should be completed simultaneously with such works. Part of this sewer was completed in 1922 at a cost of two million dollars, providing an outlet for the sewage of the city of Evanston and the north shore towns up to the Lake County line. Another section of this sewer was about 96 per cent completed on January 1, while a third section had not yet been contracted for and five other sections are in various stages of construction.

The North Side sewage treatment works, designed to treat all the sanitary sewage originating in Chicago north of Fullerton Avenue, together with the sewage from the north shore towns to the Lake County line, will have a capacity to handle the sewage of more than 800,000 people. The total cost is estimated at about thirteen and a half million dollars. On January 1 the tanks and galleries were 93 per cent completed, the thickener mechanisms 99 per cent, sluice gates and aeration plates were entirely completed, centrifugal pumps 96 per cent complete; while of other items such as meters, blowers, electrical equipment, grit chambers, air conditioning equipment, pump and blower house and other details, none was more than 46 per cent completed and the pump and blower house had not yet been started. The completion of this work by 1928 is the most important duty of the trustees.

The North Branch sewage pumping station is a necessary link in the north side intercepting sewer system and will replace the existing Lawrence Avenue pumping station with a larger station, electrically operated. It is estimated to cost about $1,300,000.

Running to Capacity

The Des Plaines River sewage treatment works are already handling somewhat more sewage than it was designed for and should be enlarged at once. Future enlargement was provided for when the works were built and ample land is available. The estimated cost of the enlargement necessary is $325,000 with an additional $75,000 for a sludge line.

The Calumet sewage treatment works have almost reached the point where additional biological treatment is needed and it is proposed to install trickling filters following the Imhoff tanks; also additional sludge drying beds. It is also recommended that experimental work to aid in devising or selecting machinery for cleaning sludge drying beds should be installed at the Calumet works; also tests made of devices for indicating sludge levels in settling tanks before their actual use in the North Side sewage treatment works.

The Calumet sewage treatment works have been in operation since September, 1922, and the Des Plaines river works since August, 1922, the sludge press and dry house of the latter having gone into operation in October of that year. In the Calumet works an Oliver filter is used and in the Des Plaines works a Berrigan press and Worthington press. The Morton Grove sewage works are now in good operating conditions as are also the Glenview sewage plant and the North Brook sewage plant, the last of which was put in operation in April, 1926.

The next step in the sewage treatment program of the district is the construction of the West Side sewage treatment works which will serve that part of Chicago north of the south branch of the main channel not served by the North Side works, together with the Loop distict and some territory immediately adjacent thereto. Preliminary studies have been made for these works and borings and test pits sunk to determine soil conditions. This plant will consist of Imhoff or double deck tanks with a sewage pumping station, grit chambers, drying beds, etc. It is being designed to handle the sewage of 1,850,000 people in 1940, including the transient population of the Loop district.

At the Waterworks Convention

Those visitors at San Diego, who went with an eye open for new and practical information on meters found a great deal to intrigue them. The leading manufacturers of water meters were represented by attractive booths, with several experts in attendance to explain the mechanical features of the different makes. Among the meter exhibitors was R. W. Sparling, of Los Angeles. Mr. Sparling personally had charge of the booth.

Wallace and Tiernan Company's "Chlorine Ions" put on quite a spread at the informal convention dinner, Thursday evening at the Hotel San Diego. Among their many guests were the following well-known engineers of the waterworks fraternity:

Dr. Carl Wilson, Los Angeles Dept. of Waterworks and Supply; Harry Reinhardt, Asst. Gen'l Mgr., East Bay Water Co.; W. F. Langlier, Asso. Prof. Sanitary Engineering, University of California; Ray F. Goudey, Sanitary Engineer, State of California; C. G Gillespie, Director, Bureau Sanitary Engineering, Oakland.

E. A. Reinke, University of California, Berkeley; R. G. Wueste, Supt., Impounding System, San Diego; W. M. Starkey, Supt., San Bernardino Water Dept.; Geo. S. Hinckley, City Engineer, Redlands, Calif.; Dr. Lieson, San Diego Health Dept.; John L. Perhab, Water Supt., Calexico, Calif.

Graydon Oliver, Modern Irrigation; Paul A. Diehl, Cons. Engr., Black & Veatch, Los Angeles; C. A. Smith, Burns-McDonnell-Smith Eng. Co., Los Angeles; R. L. Derby, Sanitary Engineer, Salisbury-Bradshaw-Taylor, Engineers; R. D. Whitacre, Supt. Tucson Water Dept.

C. T. Henderson, Chairman, Water Commission; G. T. Luippold, A. L. Frick, Jr., and Alexander Bell of Wallace & Tiernan Co., and Geo. H. Bragg, Chief Engineer, Pacific Gas & Electric Corp.

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7

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Fifty Years of Progress in Sewage Disposal is Tribute to the Scientist

IT WAS just fifty years ago, says Robert Spurr Weston in Industrial and Engineering Chemistry, that Colonel George E. Waring, Jr., described a closed tank for sewage treatment which he had built at Newport, R. I., and in which "the solid deposit of organic matter decomposes in the form of ammonia, which helps dissolve the grease and make it soluble so that both the deposit and scum are constantly wasted." This tank had its prototypes in France and elsewhere. Its modern representative is the septic or biolytic tank, improved in this day by separating digestion from subsidence, using two-storied tanks like the Imhoff tank, or separate digesting tanks as recommended by Clark and used successfully at Baltimore.

The digestion of sewage solids by hydrolysis is due to various groups of anaerobic bacteria which were not known fifty years ago and were not studied carefully until this century. At the present time these useful deoxidizing organisms, and the conditions under which they will best function, are better understood, even though much work remains to be done.

The contact bed is practically a tank containing a coarse contact medium (broken stone) and filled with sewage, emptied, and rested in cyclic order. It combines oxidizing and deoxidizing functions; that is, it both liquefies and nitrifies organic matter. Furthermore, because of the large surface in contact with the sewage, it furthers clarification. It is less used than formerly, although it produces better effluents than are produced by plain subsidence or screening. It is now used chiefly either where a high degree of purification is not required or preliminary to intermittent filtration through sand.

The trickling filter of coarse material over which sewage is sprayed or otherwise distributed mechanically is a development of thirty years. It is the result of trying to expose sewage in thin layers to a large contact surface, alive with aerobic bacteria and well aerated. Usually this device produces a nonputrescible effluent, turbid with humus-like matter, which latter is usually removed by the secondary subsidence before the final discharge of the effluent. A recent development at Fitchburg, Massachusetts, and elsewhere, is the return of this humus-like sludge to the Imhoff tank, which precedes the filter.

BASKING IN SAN DIEGO'S SUNSHINE AT THE WATER-WORKS CONVENTION

Top, left to right: Wm. Mulholland, chief engineer; Wm. W. Hurlburt, office engineer; Jas. E. Phillips, asst. engineer, all of Los Angeles water department; and L. N. Slater, manager Western Pipe & Steel Co.

Center: Alexander Bell, Wallace & Tiernan Co.; C. T. Henderson, Great Western Chemical Co.; A. L. Frick, Jr., Wallace & Tiernan Co.

Bottom: Andrew Ervast, chief engineer, Spreckles Co., San Diego; Virgilio Bruschi, city councilman, San Diego; A. P. Lovell, superintendent water department, San Diego; R. W. Martindale, U. S. Cast Iron Pipe Co.; and J. J. Swenson, American Cast Iron Pipe Co.

Activated Sludge Process

The activated sludge process was developed by Clark at Lawrence, Massachusetts, and by Fowler and his associates at Manchester, England, and was improved in principle by Bartow, Mohlman, Pearse, Hatton, Copeland, and others. It consists, in brief, in agitating sewage in contact with air and an accumulation of its own sludge. It is the acme of treatment by oxidation. The sludge particles, bearing nitrifying and other bacteria, circulate through the liquid, causing both flocculation and oxidation. Separation of sludge in the effluent is effected in tanks or clarifiers, the latter device being an adapted ore-dressing machine. The effluent from this process is excellent.

Mention must be made of the development in the way of preliminary treatment by screens, grit chambers, or subsiding basins, without which the operation of filters and activated tanks would be difficult. Practically all these devices, with the exception of plain subsiding basins, have come into use within fifty years.

Precipitation By SO_2

By adding lime and other chemicals the precipitation of organic matter may be accelerated. This process has come and largely gone during fifty years. Precipitation by sulphur dioxide has been suggested by Miles. It produces a partially disinfected sludge of low water content and high in recoverable fats and potential fertilizer value. The practicability of recovering the fats and fertilizer from this awaits research.

Supreme Court Holds City Liable in Typhoid Damage Suit

Washington State Tribunal Rules That Lack of Proper Inspection Constitutes Negligence by Municipality

"There are a few leading cases," says the Nation's Health, "in which compensation has been granted workmen for disease such as typhoid fever contracted through impure drinking water furnished in places of employment. Instances where damages have been awarded against a city for similar offenses are rather unusual. For this reason, the two following citations are of interest to health workers. They both apply to the same period of pollution but different legal points are cited in each case.

"The facts upon which claims were based (Aronson vs. City of Everett, Supreme Court of Washington, 239 Pac. Rep. 1011) were that the city of Everett, Washington, permitted access of polluted river water to the city mains which was consumed by different citizens, some of whom contracted typhoid fever with fatal results. The pollution entered the city mains through a cross connection in one of the local mills. This bypass was guarded by the usual check valves and a gate valve. Usually the pressure in the city mains was higher than that in the water system of the mill. Also, the gate valve was supposed to be kept closed at all times.

"It was subsequently found that during the relaying of some new pipe this valve had been left open, permitting access of the polluted river water to the city mains.

Holds City Negligent

"Under the case at issue, Mrs. Aronson contracted typhoid fever and her husband brought suit for damages against the city in which he obtained a verdict of $6,000, apportioned $2,000 to each of two children, three and six years of age, and $2,000 to the husband.

"On appeal it was contended that the city could not warrant absolutely the purity of the water, but the court held that the city was negligent in not protecting its supply from pollution. In dismissing this contention the court said that while former cases cited by the appellant 'hold that a city furnishing water to its inhabitants does not impliedly warrant that the same is pure and wholesome, yet both these cases recognize that the failure to properly inspect the water so as to keep it free from contamination is negligence. There is ample authority that a city engaged in furnishing water, electricity, or other kindred services to its inhabitants for a profit is liable for negligence the same as any private corporation engaged in the same business,

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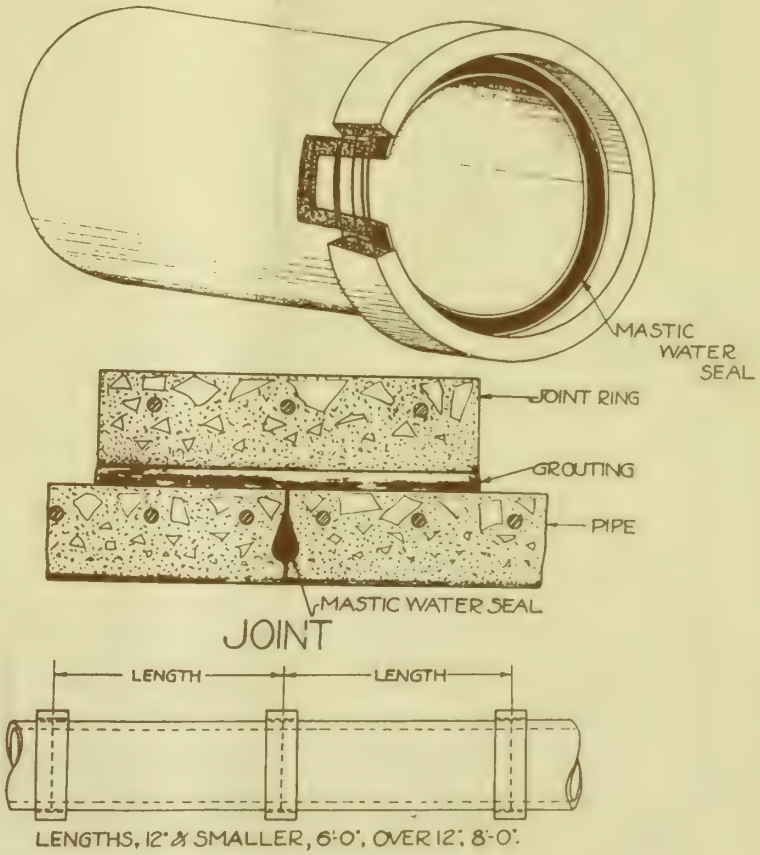

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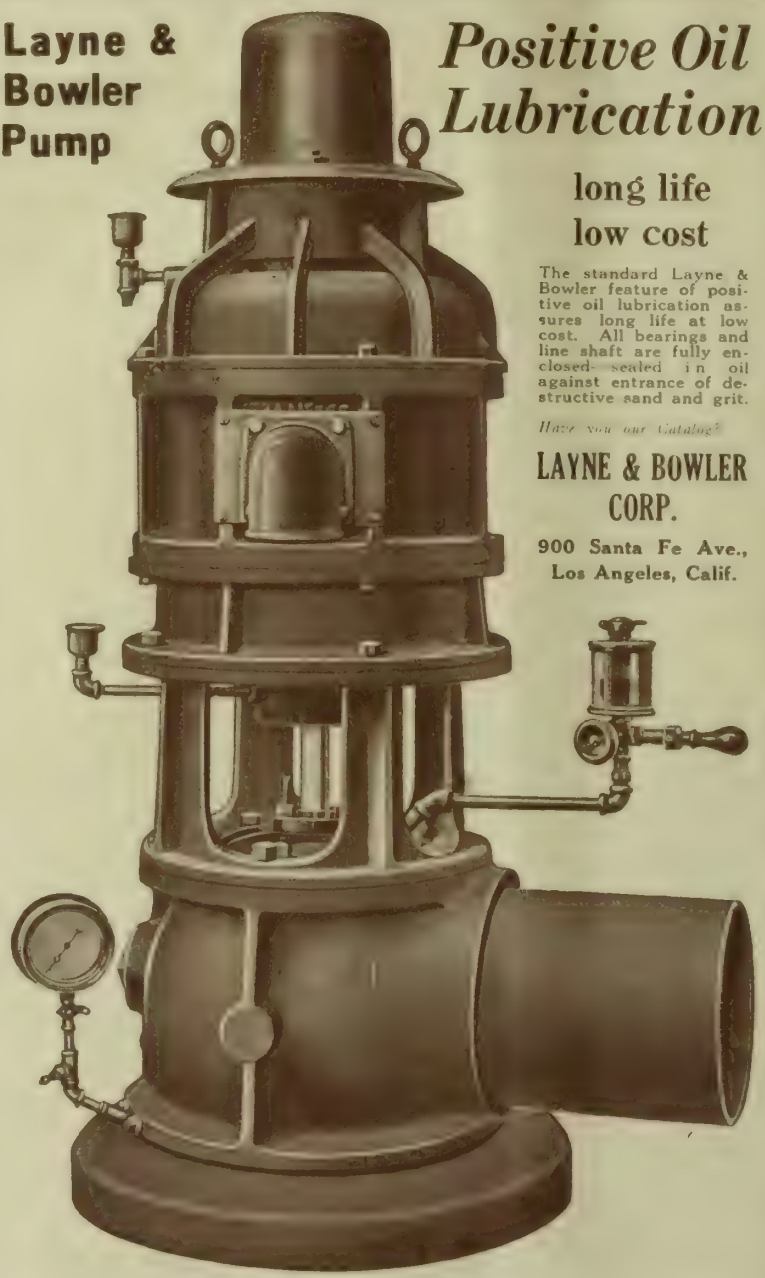

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that the city does not act in a governmental capacity, and that there is an implied warranty that the water is fit for human consumption. . . . As to which rule should be adopted it is not necessary for us to determine in this action, since we hold the complaint is based upon the ground of negligence and not on implied warranty.'"

Two Measures Advised to Check Siltage of Reservoirs

U. S. Forest Service Advocates Planting of Trees and Establishment of Settling Basins

The Department of Agriculture, through the Forest Service, has called attention to the danger to water-power and water-supply development through erosion and silting up of reservoirs. The planting of protective woods and the establishing of settling basins are two of the preventive measures advocated.

The full text of the statement follows:

Suggestions that may add to the value of waterpower and water-supply developments are made in a bulletin just issued by the Forest Service, United States Department of Agriculture, entitled "The Financial Limitation in the Protection of Reservoirs,'" by W. W. Ashe. It is of interest to investors of such properties and to engineers.

Siltage Reduces Ponds

Storage of water is becoming a recognized factor in hydroelectric development, just as it is necessary in most cases for municipal supply. This bulletin shows that with storage there enters the problem of siltage through erosion of soil, an insidious agency which may cause loss of pondage and consequent reduction in the capacity of reservoirs.

The rapidity of erosion and of silting up of reservoirs is affected by different physical and meteorological conditions in the different regions of the United States. Over the greatest portion of the northern and northwestern United States and in Canada erosion is not the serious problem that it is in parts of the southeast and particularly in portions of the southwest.

The bulletin calls attention to the high silt burden of certain streams and the rapidity with which storage capacity of reservoirs is reduced, as in the case of the Colorado River (of Texas). The reservoir at Austin on this river lost more than its capacity within ten years.

Many other streams carry a silt burden fully as great as that of the Colorado. On the basins of certain of these streams, according to Mr. Ashe, the surface conditions are such that erosion can be only slightly lessened. On these it is a natural condition, the result of con-

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centrated rainfall on surfaces naked of protective vegetation on account of irregular rainfall. There are other regions, the bulletin points out, where protection of the surface is highly efficacious in reducing erosion.

Silting Can Be Measured

It is shown that it is possible to ascertain the rate of silting which is taking place and from this to determine the capital value of the storage capacity, the loss of which might be expected within a given period. It is also possible to determine the extent to which excessive erosion may be checked by artificial means.

Mr. Ashe proposes a formula for determining how much money could be economically expended to maintain this capital value, which otherwise would be destroyed by siltage. He points out that in case woods are artificially established for the purpose of securing soil cover and reducing erosion a definite return can be expected from the investment therein, but that power and water companies are justified in making additional expenditures which would be within the capitalized value of the storage capacity which will be preserved.

In the Southern Appalachians as well as elsewhere there are alluvial lands which have been injured during floods by gullying or by the deposit of sand and gravel. Where such conditions exist there is, in the opinion of Mr. Ashe, an opportunity for the establishment of settling basins.

Settling basins of the kind he proposes would not only result in the elimination of much silt from the stream but also would bring about the rehabilitation of the devastated lands, which, after being built up by deposit of the sediment, would again be available for farming. Since this sediment as a rule consists largely of the most fertile soil eroded from the surface of the watershed, areas thus built up would be very productive.

Copies of the bulletin, which is designated as Department Bulletin 1430-D, can be obtained from the Forest Service, United States Department of Agriculture, Washington, D. C.

Ralph R. Woolley, a hydraulic engineer of Salt Lake City, Utah, is now editing the Utah Engineer, a new periodical published in the interests of Utah engineering. Mr. Woolley has at various times been connected with road material tests and a number of hydroelectric and irrigation investigations. Since 1917 he has been connected with the U. S. Geological Survey, classifying public lands with regard to water power and irrigation possibilities.

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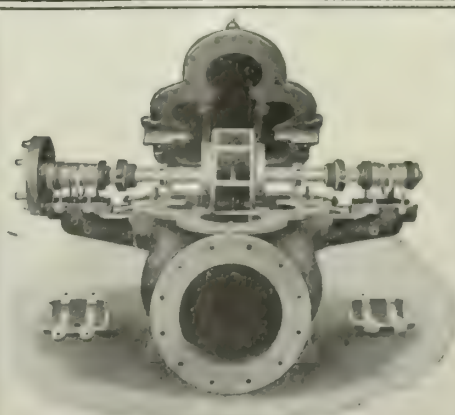

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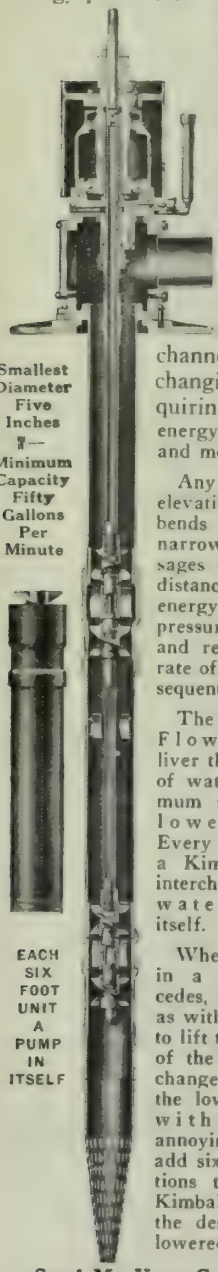

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When the water level in a Kimball well recedes, it is not necessary, as with other type pumps, to lift the entire pump out of the well to make the change necessary to reach the lowered water level, with the accompanying annoying delay. Simply add six-foot pumping sections to the top of the Kimball pump, adding on the desired length to be lowered, does the job.

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The Biological Control of Reservoirs

(Continued from Page 40)

Following this, the steep sides, which were subject to storm wash, were oiled and rolled with a view to prevent cutting. When the lake was filled there was no vegetation of any kind below the flowline, and the incoming water was all filtered. Black bass, blue perch, and carp stocked the lake, and multiplied rapidly. Here was a clear case of unbalanced biological conditions—all animal life. Naturally enough, plankton growths appeared, and they were held in check by the usual copper treatments, but in spite of our best efforts the water became stagnant and had to be withdrawn from service.

Briefly, the oxygen demand of the fish population (necessary to keep down insects) was in excess of the supply derived from the inflowing water and from surface absorption, so that anaerobic bacterial activity spoiled the water. Artificial aeration with the compressors was tried, but owing to the area and shape of the lake, it was not a success. Considerable growths of Scenedesmus, one of the green algae, appeared at midsummer, and were allowed to go on unchecked, as the reservoir was out of service, and practically devoid of dissolved oxygen at the surface. Scenedesmus happens to be one of the most benign algae, but candidly, we feared to use copper, thinking it would make bad matters worse.

Algae Save the Day

Contrary to expectation, as the growth increased, the quality of the surface water steadily improved, apparently due to release of oxygen by the green algae as a by-product of photo-synthesis. The plants had saved the day. Since then we have been able to utilize several of the algae in this manner with marked improvement in the upper waters. In fact, this simple expedient has enabled us to retain the lake in service all summer, skimming off the top layers, whereas otherwise it would have been necessary to put the reservoir out of service. Naturally, not all algae can be employed in this way, but generally speaking those members of the Chlorophyceae which are known not to be producers of foul odors, may be used.

Not infrequently birds assume importance on reservoirs, particularly those which send water directly into service. Swallows nesting around an outlet tower have been known to add colon bacilli to water which was otherwise perfect, thus necessitating a chlorine treatment that would not have been required. Obviously the remedy is to prevent nesting about the outlet works.

In Los Angeles we have had several instances where water fowl have carried Peridinium from the brackish sloughs near Wilmington, or perhaps from the open sea, to our distribution reservoirs. This organism is exceedingly interesting and even useful in the ocean, but it is always an unwelcome visitor in reservoirs, because it makes the water rusty red in color, and imparts a most unpleasant odor and taste when the growth finally dies.

Other Bird Offenders

Cormorants are also undesirable about a reservoir, first because they may seriously deplete the stock of fish, and second because of their unclean habits. Like swallows, they haunt the outlet towers and sadly deface the structures. It has been found desirable in Los Angeles to drive them off the reservoirs by shooting.

The worst bird offenders, however, are sea gulls and mudhens. In the fall it is a common thing for 10,000 or more gulls to rest on one of our lakes at night, and the amount of guano which they deposit in the water is sufficient to become a matter of real importance. Probably 30 grams per day per bird is conservative estimate, and when this is multiplied by the immense numbers of birds present it is easy to see how it may effect the quality of the water. Increase in B. coli content is the least serious result, for chlorination may be made to remove these bacteria. The amount of oxygen consumed in the reduction of the fecal matter is great enough to seriously deplete the available reserve, and when this has been done, anaerobic bacterial activity quickly spoils the water.

In the Los Angeles reservoir referred to above, we feel confident that the exhaustion of oxygen has been largely due to birds. Moreover, the fertilizing value of the guano stimulates luxuriant growths of algae, for these plants are quite as susceptible to the effects of fertilizers as are the farmers' crops. To be sure, growing algae furnish free oxygen to aid in the reduction of organic pollution, but many types cannot be permitted to grow long enough to accomplish real aid in this way, for they would give rise to their own peculiar bad tastes in the water.

Economic Control Desired

Because of the complexity of these actions and reactions, the problem of control is far from simple, but even here some benefit is to be derived by pitting the activities of plants against those of animals. So far, however, we have obtained our best results by shooting at the birds sufficiently to drive them from the lake.

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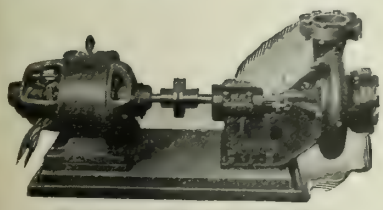

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The control of pollution on an impounding reservoir is at once the most important and most difficult of problems in economic biology. It is well to accentuate the fact that what we desire is *economic* control, for the whole solution of the problem hinges upon economy. If natural purification can be depended upon to accomplish the desired results it would be unwise to spend money to do it artificially. Naturally, gross pollution must be removed regardless of cost, but where adequate storage is afforded and draft is made through a distribution reservoir, too much money must not be spent on the impounding system.

Under ordinary conditions it is better practice to regard this branch of biological control as belonging to distribution reservoirs, but of course where one reservoir acts in both capacities, as Sweetwater reservoir, it is necessary to treat the lake as a distribution reservoir and eliminate all possible contamination. This policy has been adopted in the case of Sweetwater, and the company has bought up most of the small holdings around the lake, removing the buildings and holding the land fallow. Continuous chlorination of the effluent is relied upon to provide final protection.

There is one more task which biology may be made to shoulder under some conditions. In the case of a water which is high in temporary hardness, that passes through a large impounding reservoir and subsequently through one or more distribution reservoirs protected by the accepted treatment plants, plankton algae may be made to materially reduce the hardness, perhaps to the entire amount of the temporary hardness. It is well known that these plants are able, after all the free carbonic acid has been removed from water, to attack bicarbonates of calcium or magnesium with the release of half-bound CO_2, which they use as food material. The normal carbonates of these bases, which result from such action, are insoluble, and hence removed from the upper layers of water where photosynthesis occurs.

Careful Study Worth While

Careful study of the biological factors affecting water under storage will undoubtedly show us many new ways of improving water. The amount of work done by living plants and animals is astonishingly great, and means will be found to direct at least part of these activities for the benefit of man. Perhaps one of the most profitable ways in which small funds can be invested is in detailed and intelligent study of fresh water biology in its economic aspects.

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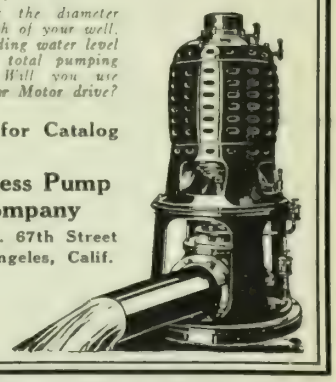

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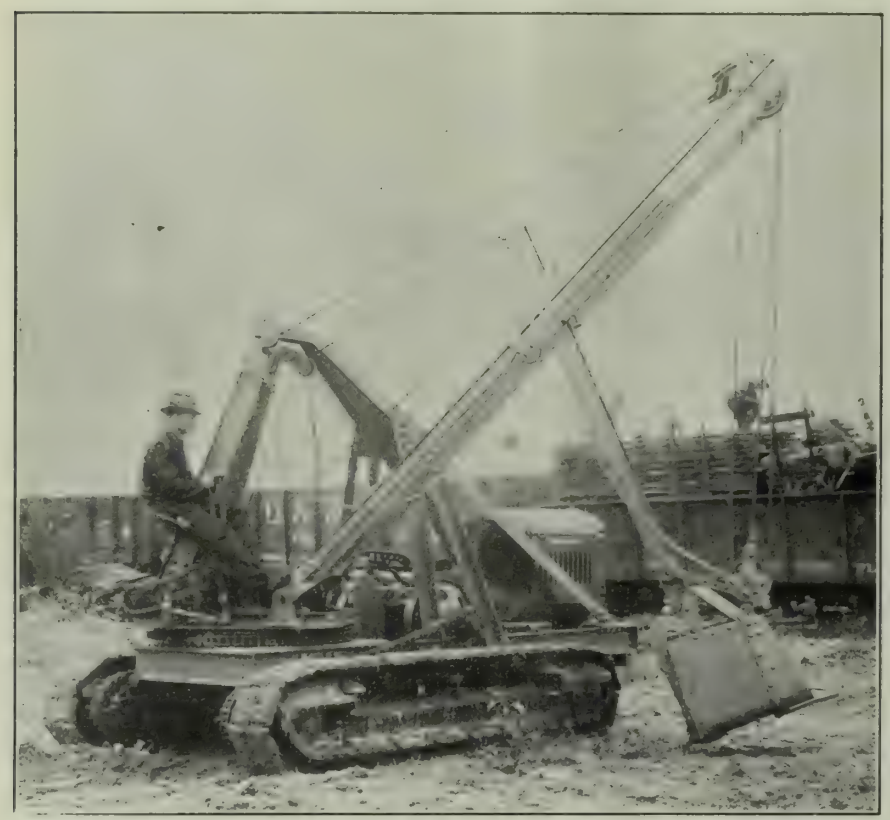

A close-up of the new tractor shovel. It is one-man operated and can be run on kerosene

THE Bay City tractor shovel, manufactured by the Bay City Dredge Works, of Bay City, Michigan, is being announced to the public following a period of exhaustive and severe tests. It is the creative work of John W. Fairbanks, designer of note, who has previously developed earlier models of tractor shovels.

This machine is built around the International McCormick-Deering Tractor, which supplies the motive power and provides three propelling speeds—the fastest of which is 3½ miles an hour—through its selective transmission. All of the operating machinery is located on a revolving bull-wheel, which is above the machinery frame.

The operator revolves with the machinery, which swings through an arc of 270 degrees. This three-quarter circle swing permits full circle utility and part circle economy. The shovel can dig or load opposite the rear end of the crawlers.

The machine is built throughout of special steels with alloy shafting; forged, heat-treated and machine-cut gears, and Timken roller bearings. It is equipped with a shovel that will make five bucket trips per minute; and with full-length steel crawler treads 9 feet long, with tread rollers enclosed to keep out dirt. The operating machinery, gears and bearings, are also enclosed under a removable metal hood for protection from weather and dirt.

One-Man Operation

The machinery is strictly one-man operated, and can be run on kerosene if desired. The shovel boom is 15 feet long, permitting the shovel to cut at a height of 17 feet or dump at a height of 15 feet. Crowding is accomplished by means of a steel worm and bronze worm gear running in oil and connected with the machine by shafts and gears. This crowd is reversible and positively self-locking.

The Bay City tractor shovel can be quickly converted into a crane, dragline or backfiller, by removing the shovel boom and crowd and putting on a 25 foot crane boom. Power boom hoist mechanism is provided for either shovel or crane.

The Bay City tractor shovel is intended to fill long felt needs for a light, small and fast convertible excavator for general excavation, loading materials from stock piles, loading or unloading cars, excavating or backfilling small sewers, curb trenches, etc. It is particularly adapted for the excavation of house basements. It can move to a job three miles away in less than an hour's time, and its high propelling speed and compact design make it the ideal machine to use on small jobs where the installation of a heavy, high-priced machine is not warranted.

The dipper capacity is 3-8 cubic yard water level measure, or practically ½-yard heaped. The machine weighs 8 tons, and is capable of digging very hard material.

Issues New Pump Bulletin

Ingersoll-Rand Company has issued a new and revised edition of the Cameron single stage, double suction, volute pump bulletin which describes in detail the three different classes of these pumps. The bulletin is excellently illustrated, showing all the details of the pump, as well as installations in various types of plants.

The Cameron single stage, double suction pumps, as described in the bulletin, are suitable for direct connection to alternating or direct current motor, steam turbine, gasoline engine, or for belt drive.

Would Cure Concrete With Liquid Sprayed on Wet Surface

Experiments With Hunt Process Show That It Has Many Advantages Over Old Methods of Curing

F. W. McRae, chief engineer of the Everlasting Paint and Sales Company, has recently been conducting exhaustive experiments upon the curing of green concrete by means of protective coatings, and has compiled a complete report of the results. It is his theory that new concrete can be properly cured by the application of a protective coating, sprayed upon the wet surface.

This theory is embodied in what is known as the Hunt Process, which is described in Mr. McRae's report as follows:

"The process consists of spraying the sub-grade just ahead of the concrete, which we find prevents the moisture in the concrete from going into the earth. If the contractor starts pouring at eight o'clock in the morning, by eleven o'clock he finds that a certain portion of his pavement has passed the runoff period, when water rises out of the concrete and a slight glaze is noticeable. If the conditions indicate a warm day, small checks appear as the quick evaporation sets in, or if the day is windy the same checks will appear. At that time, with the Hunt Process (protective coating) he could move his spraying machine up to the concrete and cover it with a protective coating which would stop evaporation and, we find, adhere to the wet surface. Possibly by the end of the day he will have protected two-thirds of his day's run. The next morning he can complete the protection of the previous day's run.

Will Remove Grief

"We do not expect this method to cheapen the cost of concrete paving to any great extent, but it will take from the contractor possibly the greater part of his grief, which is the curing and protecting of the pavement after laying. For instance, under the present method the sub-grade is dampened to a point of saturation, which to some extent protects the moisture in the concrete; next, a certain amount of earth must be left for covering purposes. This earth is naturally handled twice, which means expense on yardage; next, as the pavement is laid, the contractor is called upon to protect it from quick evaporation either by light spraying or covering with burlap or canvas, and the following morning a layer of from four to five inches is placed on the pavement by hand.

"This covering as a rule must be completed before noon, which means that the

(*Continued on Page 65*)

For Cleanout -- Maintenance -- New Ditches

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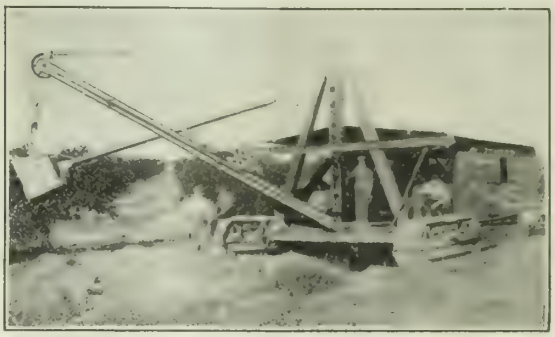
BAY CITY Land Dredges span the ditch, can dig any desired slope, and dump waste on both banks. BAY CITIES leave clean, wide berms, and can work up or down streams. One trip over the ditch is enough. The Shovel Type Dipper handles hard material in which other types of buckets cannot make a good showing.



At left—One yard BAY CITY Dredge digging and cleaning ditches in Florida Citrus Groves.

BAY CITY Land Dipper Dredges are built to fit the job. Walking, Crawler, Track or Floating mounting. Easily dismantled, transported and assembled. Capacities ½ to 1½ cubic yards. Oil engine or electric operation.

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The BAY CITY 16-B convertible Excavator will handle a wide range of work. Operates Dragline, Trench Shovel, Clamshell or Skimmer. All steel. Shipped assembled. Digs any width or depth up to 20 feet.

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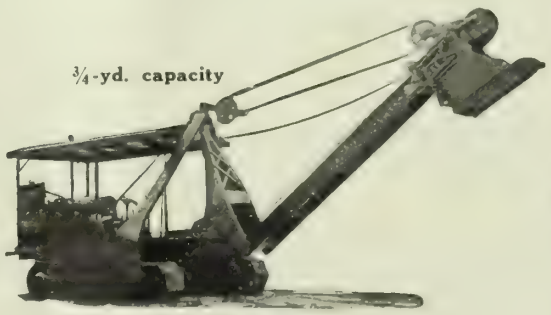

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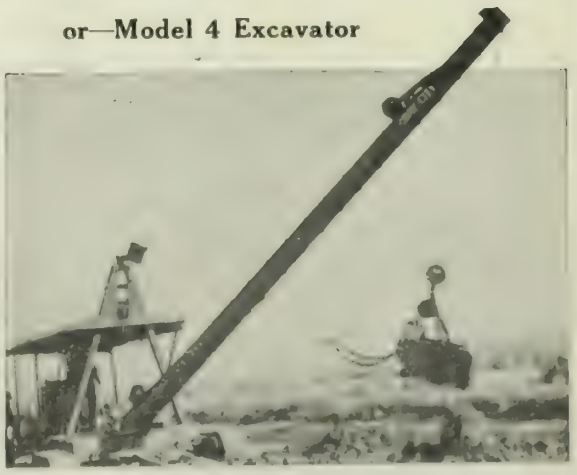

One of the Model 4's Owned by Colorado Irrigation Companies. Cleaning Out Canal.

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WHO'S *WHO* AND WHO'S *WHERE*

IN THE WORLD OF HYDRAULICS

Personal Notes and Impersonal Observations About Men You Know

B. A. Shumakov, irrigation engineer from Russia, recently visited the Yuma project, Arizona.

George C. Kreutzer, director of reclamation economics, conferred recently with owners of unimproved lands on the Orland project, California.

Glenn F. Engle, assistant engineer on the Newlands project, Arizona, has resigned to devote all his time to his ranch interests.

N. C. Grover, chief hydraulic engineer of the United States Geological Survey, recently visited the American Falls Dam, Idaho.

J. R. Iakish, associate engineer on the Shoshone project, Wyoming, has been transferred to drainage investigations on the Vale project, Oregon.

F. A. Kern, secretary of the Kittitas Reclamation District, Washington, paid a recent visit to reclamation headquarters in Washington, D. C.

T. R. Smith, junior engineer in charge of hydrography at American Falls Dam, Idaho, has been transferred to the Denver office of the Bureau of Reclamation.

B. T. Ploeger, levelman on the Shoshone project, Wyoming, has resigned to accept employment on the municipal water supply works for the East Bay cities, California.

J. J. Doland, assistant engineer in the Denver office of the Bureau of Reclamation, has resigned to accept a position as instructor in the College of Engineering, University of Illinois.

Professor Frank Adams, of the University of California, one of the members of a committee appointed to resurvey the levee of the Imperial Irrigation District, California, has begun preliminary work on the survey.

F. A. Banks, engineer in charge of the American Falls dam, Idaho, has been put in charge of the construction of the Owyhee dam and the canals and water distribution system, according to a recent report from Boise, Idaho.

Dean Phillips S. Donnell, of the University of New Mexico, gave a recent address before the New Mexico Association for Science on the proposed developments of the Middle Rio Grande Conservancy District.

Mrs. Laura E. Varco, named as director for the one-year term in the Snow Creek irrigation district, Oregon, is believed to be the first woman in Central Oregon elected to the board of directors of an irrigation district. She succeeds Paul Scoggin, resigned.

William M. Green, who has been in charge of the investigation of the Great Basin reclamation project in Utah, has resigned his position with the United States Bureau of Reclamation to become affiliated with the J. G. White Engineering Corporation in Mexico.

Stan Spacek, a representative of the Cchezoslovakian Government, is planning a trip, according to a report from the Bureau of Reclamation, that will take in the various reclamation projects where construction is going on, and particularly those where dams are being built.

C. C. Cragin, general manager of the Salt River Valley Water Users' Association, Arizona, made a recent trip to Washington, D. C., to secure approval of a contract for additional sale of electric power which is expected to add $250,000 to the annual revenues of the Salt River project.

M. J. Dowd, according to a report recently received from Imperial, California, has been made chief engineer and general superintendent of the Imperial Irrigation District with jurisdiction over the entire system. Mr. Dowd has been with the district for several years and prior to his appointment as general superintendent had been water master of the system with Calexico as headquarters.

Edward Hyatt, Jr., chief of the division of water rights of the State Department of Public Works at the semi-annual conference of the California Economic Research Council, recently held in Los Angeles, delivered an address on the subject of the relationship of economic research to California water problems.

W. P. Boone, of Dinuba, California, has been chosen chairman of the management board for the Pine Flats project. The other members of the board are: Charles L. Kaupke, Fresno, secretary; Harry L. Haehl, San Francisco; George L. Swendsen, Fresno; E. R. Reed, Reedley; R. E. Shore, Lemoore; and W. H. Shafer, Selma.

H. W. Nicoldsen, of the irrigation service of Punjab, India, paid a recent visit to the Denver office of the Bureau of Reclamation. He consulted with the officials of the bureau with regard to an itinerary for a trip he is planning through the western states to obtain information concerning high dam construction methods.

H. F. McPhail, electrical engineer in the Denver office of the Bureau of Reclamation, has made a recent study of the proposed pumping site at Shell Rock Point, Okanogan project, Washington. According to a report from the bureau, he also ran out trial lines for the proposed pump main from the river to the project canals, and looked over the McLaughlin Canyon dam site and the possibility of storage of water in Osoyoos Lake.

W. P. Davidson, president of the Oregon-Western Colonization Company, has volunteered, according to a report from Burns, Oregon, to underwrite the cost of casing for a thorough irrigation well test. At the same meeting P. S. Weittenhiller agreed to drill the well without immediate advancement of the costs. These proposals are said to make possible the establishment of an eighty-acre demonstration farm in connection with the Harney branch state experiment station for the testing of irrigation possibilities under field conditions.

Buell Dam Contract Let

At a special meeting of the board of directors on October 27, 1926, contract was awarded to Messrs. Kraner & Haskell of San Francisco for the construction of the Buell Reservoir Dam, Montecito County (Calif.) Water District.

This dam, which is to be a hydraulic fill with concrete cut-off wall and Gunite surface on upstream face, will form a storage reservoir of 63,500,000 gallons and is located on the south side of the Coast Range in Montecito, about six miles east of Santa Barbara, and will form an equalizing and storage reservoir on the district's distribution system. The dam will contain about 140,000 cubic yards of earth fill. Construction will be commenced immediately, and it is estimated that about eight months will be required to complete the dam.

Messrs. Leeds & Barnard, 704 Central Building, Los Angeles, are consulting engineers for the district, and Carl Wyant, Montecito, is general manager for the district.

MONTECITO COUNTY WATER DISTRICT
Bids for Construction of Buell Reservoir Dam Received Oct. 19, 1926

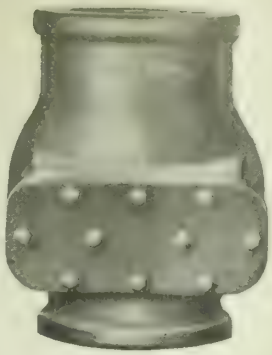
Contractor	Storage Cap. (Gals.)	Est. Cost to District	Est. Cost per Mil. Gal. Storage
Bent Bros.	45,000,000	$146,794 (5)	$3,262 (6)
Bates & Borland	63,500,000	166,157 (6)	2,617 (3)
Kraner & Haskel	63,500,000	142,165 (3)	2,239 (2)
Dwight P. Robinson Co.	45,000,000	143,121 (4)	3,180 (5)
J. G. Donivan & Son	63,500,000	131,342 (2)	2,068 (1)
FitzGerald Engr. & Const. Co.	45,000,000	123,621 (1)	2,747 (4)

California Water Survey Ready

After six years of work the report on California's water resources will be ready for submission to the 1927 legislature, according to an announcement made by State Engineer Paul Bailey. Authorization for the survey was first given by the 1921 legislature, which voted $200,000 for the work. Subsequent appropriations by the legislature brought the total for the survey to $440,000. Mr. Bailey has not as yet determined whether the report will embody recommendations by his office, or whether the document, containing several plans of water conservation and control, will be presented to the legislature without comment as to the merit of the various schemes. One of the features of the report will be the plan to irrigate the thousands of arable but uncultivated acres in the San Joaquin Valley by the surplus water of the Sacramento River.

Issues Mortgage to Guarantee Payment

Roseville Water Company has been authorized by the California Railroad Commission to file its mortgage guaranteeing payment of $180,000 of bonds heretofore authorized by the Railroad Commission.



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Luminite

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LEGAL *and* JUDICIAL

A DEPARTMENT CONDUCTED BY HANKINS & HANKINS

Willful Failure to Supply Water Subject to Punitive Damages

An officer of a water company is also liable where acts are done under his direction.

In the case of Gila Water Co. vs. Gila Land and Cattle Co. et al., 249 Pac. 751 (Ariz. Oct. 5, 1926) the plaintiff Land Company, in a trial before a jury, obtains a judgment against the Water Company, and also its president, for the sum of Twenty-Four Thousand Four Hundred Fifty and no/100 ($24,450.00) Dollars, actual damages and Five Thousand and no/100 ($5,000.00) Dollars, punitive damages. The damages arose through the alleged, willful, unlawful and wrongful acts of defendants in depriving plaintiff of the use, during the growing season, of irrigating water. The judgment against the president is supported by the allegation that he personally directed or dictated the willful, unlawful and wrongful diversion of plaintiff's irrigating water.

In upholding the judgment against both defendants and for both actual and punitive damages, the Supreme Court of Arizona states:

"We think it is very well settled that an officer of a corporation who directs and controls its operations is equally liable for the commission of torts by the corporation done under such officer's authority or direction or with his approval. In such circumstances the officer is regarded as a joint tort-feasor. It is urged that there was no evidence justifying the submission of the question of punitive damages to the jury . . . . Exemplary, punitive, and vindicative damages mean practically the same thing, and comprehend damages inflicted upon a party over and above actual damages for the purpose of punishment and as a deterrent . . . . The question is, was the taking and converting of plaintiff's water done with a reckness disregard for, or a willful indifference to, the rights of plaintiff? If from the evidence it may reasonably be concluded or inferred that defendants assumed the attitude of intending to take plaintiff's water, deeming it sufficient justification that they were able to pay any damages that might result therefrom if it should be ultimately determined they had no right to such water, then the question of punitive damages was properly submitted to the jury . . . . Under such circumstances, we think the Court properly submitted the question to the jury to determine whether the defendant's act was wilful and in reckless disregard of plaintiff's rights, or whether defendants acted in good faith believing they were entitled to use the water they took."

Long Continued Use of Ditch Becomes a Right

The fact that claimant contributed to the ditch upkeep is evidence of a definite right in the ditch.

In the case of Miles vs. Fletcher 249 Pac. 781 (Wash. Oct. 8, 1926) the parties using a ditch became involved in a controversy and the upper land owner (defendant and appellant) refused to allow water to reach the lower land owner (plaintiff and respondent). A suit is brought to enjoin any interference with the ditch, and in deciding that plaintiff had a permanent right in such ditch and not merely a "permissive right" the Supreme Court of Washington stated:

"Under these facts it cannot be held that the right to the use of the ditch by the respondents and their predecessors in interest was permissive; but, on the contrary, it must be held that such use for more than the statutory period was under a claim and color of right, and that the appellants and their predecessors in interest in standing by, encouraging, allowing, and permitting the respondents and their successive grantors to expend money and labor in the improvement and maintenance of the ditch puts the appellants in a position that will not allow them to deny the fairness and correctness of the judgment from which they have appealed."

Agreement to Install and Maintain Drain Constitutes an Easement

A purchaser, seeing such drain, is put on inquiry as to agreement for maintenance.

In 1901 two adjoining property owners each built a drain on his own land and then connected the two so as to make one complete drain. An oral agreement was entered into between the parties whereby each was to pay the expense of constructing, maintaining and repairing his own drain. Later, owners of the lower drain changed this drain from wood to tile. In 1918 the upper owner also changed his drain to tile but the lower owner refused to allow him to connect up with the lower drain. A suit is brought to enjoin the lower owner from interfering with the connection of the two drains.

In upholding the right of the upper owner to make such drainage connection, the Supreme Court of Colorado in the case of Schneider vs. Cross 249 Pac. 643; (July 6, 1926) holds on the various points made by defendants as follows:

"Full performance for 17 years of oral agreement by adjoining landowners for the installation and maintenance of a drain takes it out of the Statute of Frauds. Such an agreement creates an easement which will run against the servient estate if the purchaser had notice of it, and a purchaser, knowing of the connection between his drain and that of adjoining land, is put on inquiry as to any agreement for maintenance."

Napa County Decision for Condemnation Held Void

A judge is disqualified to hear a condemnation suit if he is a stockholder in a bank holding a Deed of Trust on the property to be condemned.

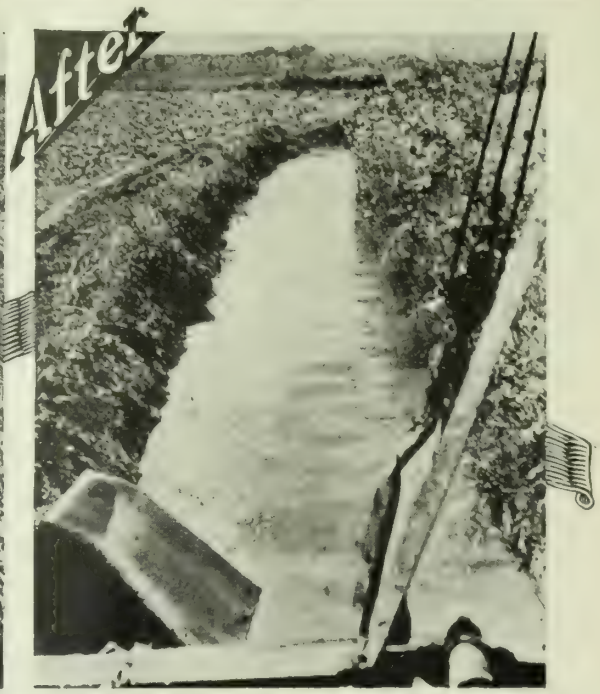
In the case of City of Vallejo vs. Superior Court of Napa County, 72 Cal. Dec. 313 (Sept. 29, 1926) the city brought a condemnation suit against various land owners to establish and maintain a reservoir to impound waters for municipal purposes. The various defendants appeared in the action and a trial was had before a jury, Judge King, of Napa County, presiding. Judgments were rendered and entered in the form of money judgments against plaintiff and allowing the condemnation. During the course of the trial an amended answer was filed by one of the defendants setting forth that the Bank of Napa held a Deed of Trust on a certain parcel of land sought to be condemned. After the entry of judgment it was discovered that the presiding judge was a stockholder of the Bank of Napa and motions were made for a new trial and to vacate and set aside the judgment, based upon the disqualification of the Judge under Sub. 1, Sec. 170 C. C. P.

In holding that the Judge was disqualified the Supreme Court states:

"The rule declared by this Court in the case of Adams v Minor 121 Cal. 372 to the effect that the Judge who is a stockholder in a bank which is a party to an action involving the validity of the bonds of an irrigation district, a portion of which is held by said bank, is an "interested" party within the meaning of Sec. 170 C. C. P. has been consistently adhered to in the later and recent decisions of this court. . . . In the face of these authorities we are constrained to hold that the interest of the respondent judge herein in these actions arising out of his relation to said bank was at all times during the pendency thereof, and still is such as to bring him within the disqualification to sit

(*Continued on Page 61*)

Digging, Cleaning Canals - *at Low Cost*



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OVERHEAD IRRIGATION

CONDUCTED BY WM. J. B. STEWART

Alfalfa Growers Look to "Overhead" for Better Irrigation

Demonstration at Chino, Calif., Shows Advantage of This System in Water and Labor Savings

The advantages of overhead irrigation on citrus groves have been so manifold that to date large installations have been almost exclusively on that type of plantings. Overhead systems will probably continue to be of more value to citrus groves than to alfalfa properties. Careful study of alfalfa irrigation by large growers and farm bureau experts, however, shows a need of better irrigation than the flooding system generally used. To quote from a recent Farm Bureau bulletin:

"Careful conservation of water, with an intelligent check-up on methods of irrigating alfalfa in Los Angeles County, is becoming increasingly important according to Assistant Farm Advisor F. H. Ernst. Excessive irrigation by the flood or surface method not only breeds trouble in some areas, causing high water tables and alkali accumulations, but contributes to direct financial losses as well. Two of the most common losses experienced by local growers are those resulting from improper field layouts where basin or checks are too large, and, the use of open ditches.

Inspection Trip Described

"At a recent tour of alfalfa growers, results of an improved surface layout were demonstrated on the T. B. Carter ranch at Lancaster, Los Angeles County, Cal. In 1925, alfalfa was irrigated in checks 30x660 feet in size. Sixty acre-inches of water were applied. By cutting the length of checks in half, the ground is now covered in nearly half the time and sufficient water supplied more economically. Due to porosity of soil and rapid penetration, practically 50 per cent of last year's water was lost through deep percolation.

"As an example of loss through open ditches, an actual measurement was made at another demonstration ranch which showed a loss of approximately 1-3 of the water during a run of 1300 feet. Twenty-one and four-tenths miner's inches were measured at the pump, of which 14½ inches remained above ground at the other end of the run. Where water is worth money, as is the case throughout Southern California, Ernst strongly urges the use of a more efficient system of distribution."

Such a system was demonstrated before a large contingent of alfalfa growers at a meeting under Farm Bureau supervision Nov. 11 at the I. B. Netzley ranch at Chino, Cal. A twenty-acre unit of alfalfa on this ranch has been equipped with overhead irrigation, pressure being supplied by a centrifugal type booster pump. As there is but a six-inch fall in the surface of this unit it was formerly very difficult to irrigate it by any method, requiring 18 days to get the water over the area. A large portion of the water was undoubtedly lost through deep percolation.

The overhead irrigation system is in three units and with three nights of operation, with practically no attendant labor, a uniformly distributed irrigation is given the alfalfa.

The system was installed recently by Albert E. Harris.

Clarence Thomas, one of the pioneers of the overhead installation business, is engaging also in the construction of reservoirs to hold the water supply for booster pumps. He has recently completed a 2,000,000-gallon reinforced concrete reservoir for the Rubio Land and Water Association at Altadena at a cost of approximately 3-4 cent per gallon of the approximate dimensions of 110x220x 12 feet deep, the site being on a gradient of 11 per cent in rather gravelly soil. The concrete was of a rich mix, 4 inches thick on the bottom, 3 inches on the sides and reinforced with 6x6 mesh. This is the third of the Association's battery of reservoirs to supply the domestic water for the district.

Fred Farrar, of Denver, Colorado, represented the Denver and Colorado Springs chambers of commerce at the Winning of the West convention in Los Angeles. While there he invited all the delegates to the convention to be present at the conference of the western states' chambers of commerce to be held in Colorado Springs early in December.

Orange County Grower Finds Natural Gas Cheapest Fuel

Overhead Irrigation Installation on La Verne Ranch Also Utilizes New Type of Sprinkler Made in East

Another overhead irrigation system operating very economically on natural gas, a fuel available rather generally through the foothill and Orange county citrus districts of Southern California, has just been completed on the 700-acre La Verne Ranch of Ralph W. Lewis. This ranch is given over to the production of grapes, grain and citrus fruits, and a second unit of overhead irrigation will soon follow the first unit of eighteen acres that has just been completed by Clarence H. Thomas of Los Angeles.

The power plant for the booster pump is a Waukesha motor that operates the No. 800 Fairbanks-Morse centrifugal pump at 86 per cent efficiency, supplying from 200 to 700 G. P. M. at 65 pounds pressure. The power cost, using natural gas, is reported to be about one-fifth that of electricity and about one-half that of gasoline, and dependable performance is obtained.

A new sprinkler, or rather one that is the result of several months of development, makes its appearance on this installation, that for the present is known as the Thomas Special, being manufactured by a large eastern manufacturer. Although the sprinkler has a coverage 140 feet in diameter, the sprinklers on the job are being set from laterals between every third row, or about 92 feet apart. The sprinkler itself, with its positive adjustments, is said to give excellent distribution and with the carefully balanced, overlapped setting of the sprinklers this installation is expected to give an ideal distribution of water.

The greatly quickened activity on small farm land in San Diego county has resulted in much overhead irrigation work being started throughout that district. The various conditions of irregular surface, porous soil, valuable water, general absence of concrete pipe systems to date, and a water suppply under pressure have combined to greatly stimulate overhead installations.

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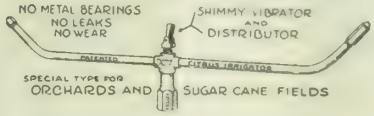

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With the California Railroad Commission

Will Buy Water System

Thousand Oaks Water Company has been authorized by the California Railroad Commission to acquire the water system supplying water for domestic and irrigation purposes in the Thousand Oaks District of Ventura County, heretofore operated by L. M. and M. E. Culver and S. Meyers and Hellman Commercial Trust and Savings Bank, trustee, and has been authorized to issue $38,100 of common capital stock for the purpose of paying therefor. A certificate has also been granted by the Commission to Thousand Oaks Water Company to operate said properties and the following rates have been fixed for said service:

Minimum monthly charge: 5/8"x3/4" meter, $1.50; 3/4" meter, $2.00; 1" meter, $3.00; 1½" meter, $5.00; 2" meter, $7.50; 3" meter, $12.00.

Monthly meter rates: From 0 to 1,000 cubic feet per 100 cu. ft. 30c; from 1,000 to 2,000 cu. ft. per 100 cu. ft., 25c; from 3,000 to 6,000 cu. ft. per 100 cu. ft., 20c; 6,000 to 10,000 cu. ft., per 100 cu. ft., 15c; over 10,000 cu. ft., per 100 cu. ft., 12c.

Grants New Rate Schedule

The California Railroad Commission has authorized Rodeo Water Company, owned and operated by S. J. Claeyes, to establish a new schedule of rates designed to yield a reasonable return upon the investment required to comply with the Commission's recent order for the development of an additional water supply and improvement of the service as follows: 3/4 and 5/8-inch meters, $2.25 per month; 1-inch, $4.00; 1½-inch, $5.50. Quantity rates: 300 cubic feet, or less, per month, $2.25; 300 to 1000 cubic feet, 39 cents per 100 cubic feet; 1000 to 3000 cubic feet, 32 cents per 100 cubic feet; all over 3000 cubic feet, 27 cents per 100 cubic feet.

Discounts Good Will Value

In authorizing Hollydale Water Company to issue $92,800 of stock for the purpose of acquiring the water system of Mercantile Investment Company in Hollydale District between the cities of Los Angeles and Long Beach, and for improvements to the same amounting to $31,600, the California Railroad Commission refused to permit the purchasers of this system to capitalize going concern value. The order of the Commission eliminated the item of $7,159.40 representing going concern value.

Asks Authority for Loan

The Hanford Water Company, supplying water to the inhabitants of the city of Hanford, Kings County, has applied to the California Railroad Commission for authority to borrow from The First National Bank of Hanford the sum of $4,000, and to execute a promissory note for the above sum payable six months after date with interest at the rate of seven per cent per annum, and to use the said $4,000 together with $6,000 now on deposit to pay an outstanding note issued to P. McRae.

Will Buy Wells and Ditches

Finnelle Land Company has applied to the California Railroad Commission for permission to sell and El Camino Canal Company to purchase a well and certain ditches and pipe lines in the vicinity of Proberta, Tehama County; and El Camino Canal Company has also applied for permission to purchase from Pacific Land Corporation two wells and ditches and pipe lines in the El Camino Rancho tract, Tehama County.

Will Establish New Rates

The Richmond Company, Incorporated, operating a small water system in Contra Costa County, has applied to the California Railroad Commission for authority to establish a $5.00 meter deposit on all new services, and a minimum monthly charge of $1.75 for four hundred cubic feet of water, and 50 cents per 100 cubic feet for all water used in excess of 400 cubic feet.

Asks Permit for Bond Issue

Haines Canyon Water Company, engaged in the distribution of water in the city of Tujunga, Los Angeles County, has applied to the California Railroad Commission for authority to issue $25,000 of bonds, bearing interest at the rate of six and one-half per cent, for the purpose of reimbursing its treasury for expenditures made to purchase necessary equipment.

Would Sell Water System

B. H. Steffen, operating a public utility water system in the city of Chico and vicinity, Butte County, under the name of Chico Vecino Water Company, has applied to the California Railroad Commission for authority to sell said system to C. B. Jackson, who has applied for permission to take over and operate same.

Would Buy Heber Waterworks

W. A. Hensley has applied to the California Railroad Commission for permission to sell and transfer Heber Waterworks to George Dyer Thompson, and the latter has applied to take over and operate the system, which supplies water to the town of Heber, Imperial County.

Edison Co. Sells Water System

Southern California Edison Company, having sold its Mound Water System in and near the city of Ventura, the California Railroad Commission today relieved that company of any further public utility obligations to furnish water in that territory.

Will Sell Right-of-Way

Port Costa Water Company has been granted permission by the California Railroad Commission to sell 6.386 acres of land for the sum of $5,250.00 to East Bay Municipal Utility District as a right-of-way for a pipe line.

Asks Permit for Water system

Ford L. Howland has applied to the California Railroad Commission for a certificate to operate a public utility water system for irrigation purposes and domestic use in the vicinity of Santa Anita Colony, Los Angeles County.

Water Company Will Sell Land

East Bay Water Company has been authorized by the California Railroad Commission to sell to Giacomo Badano approximately 5.71 acres of land in Contra Costa County, for the sum of $2,280.

For Detailed Listings, Branch Offices, Etc., See the Buyers' Guide to Leading Supply Sources—Page 67

Legal and Judicial News

(*Continued from Page 56*)

or act therein defined in Sec. 170 Sub. 1 C. C. P. It follows necessarily that whatever actions, orders or judgments have been taken, made, given or entered by said Judge in said action, or either of them, during the existence of such disqualification, the same and each of them were, are and continue to be wholly void."

Change in Point of Diversion Must Not Injure Later Appropriation

Under Idaho Statutes action of Commissioner of Reclamation in granting permit for change of point of diversion is not exclusive.

In the case of Crockett vs. Jones 249 Pac. 483; June 26, 1926, the Supreme Court of Idaho held that the remedy of an appeal to the District Court provided by the State statutes from the action of the Commissioner of Reclamation, granting a permit for a change of point of diversion of waters, is not exclusive, but cumulative, he being an administrative officer without judicial power. Instead thereof the aggrieved party might bring an original action in such court for determining the question involved in the proceedings before the Commissioner.

In the case before the court it appears that the water supplied to the appropriator arose below the point to which he desired to move his point of diversion. By reason of these conditions the court stated:

"An appropriator of water may not change his point of diversion, under C. S. par. 5563 to a point higher up stream, if water supplied him arose between the two points, and such condition existed at the time of the subsequent appropriations, and the change would injure the subsequent appropriators."

Taxes Can Be Paid Only in Money.

Acceptance of checks by collector or treasurer is not payment.

A decision of interest to Irrigation District officials (such officials corresponding with county officials) is rendered by the Supreme Court of South Dakota in the case of Eggleston vs. Plowman, as Treasurer, 207 N. W. 981 (44 A. L. R. 1231). In that case the court held:

"A County Treasurer has no authority to accept anything other than money in payment of taxes unless expressly authorized to do so by statute.

"In the absence of an express agreement otherwise, payment by draft or check is conditional payment ripening into payment only when the draft or check is in fact paid.

"The rule that want of diligence in presenting for payment a draft sent in satisfaction of a claim extinguishes the liability of the drawer, cannot be applied in favor of a taxpayer sending a bank draft to the collector in payment of taxes, and therefore the negligence of the collector in failing to present the draft for payment before the insolvency of the drawer, so that the draft becomes uncollectable, does not release the taxpayer from his liability for the taxes, and Mandamus will not lie to compel issuance of tax receipts by the tax collector."

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SURVEY *of* HYDRAULIC DEVELOPMENT

As Shown by Official Records of the Month -- Local, State, and Governmental

Applications Filed

Among the more important applications for permit to appropriate water filed with the California Department of Public Works, Division of Water Rights, during the month of October, 1926, were the following:

Application No. 5225 (San Bernardino County)—Walter A. Geft, 4816 6th Ave., Los Angeles, Calif. for .12 cubic foot per second from Old Sheep Corral Springs (2) tributary to Santa Ana River to be diverted in Sec. 34, T 2 N, R 2 E, S. B. M. for domestic and irrigation purposes on 25 acres in Sec. 27, T 2 N, R 2 E, S. B. M. Estimated cost $1200.

Application No. 5229 (Eldorado County)—Dr. A. L. White, Placerville, Calif., for 150 acre feet per annum from Shingle Creek tributary to S. Fk. American River to be diverted in Sec. 19, T 11 N, R 10 E, M. D. M. for irrigation purposes on 80 acres.

Application No. 5230 (Butte County)—Mrs. L. A. Kister, Rt. B, Oroville, Cal. for 2.21 cubic feet per second from Feather River tributary to Sacramento River to be diverted in Sec. 10, T 18 N, R 3 E, M. D. M. for irrigation purposes on 177 acres in Secs. 10 and 11, T 18 N, R 3 E, M. D. M. Estimated cost $10,000.

Application No. 5231 (Sacramento County)—William McLauchlin, 8 Atlantic Ave., Long Beach, Calif., 3.00 cubic feet per second from Linda Creek tributary to Sacramento River to be diverted (1) intersection of Lots 41, 43, 48 and 49 (2) on Linda Creek on line between Lots 33 and 34 both in Rio Linda Subdivision No. 1 for agricultural purposes on 100 acres alfalfa. Estimated cost $1,500.

Application No. 5232 (Plumas County)—J. N. Evans Estate Co., 539 Riverside Drive, Reno, Nevada, for 200 acre feet per annum from Taylor Lake tributary to Hungry and Indian Creeks to be diverted in Sec. 35, T 27 N, R 11 E, M. D. M. for agricultural purposes on 510 acres alfalfa and general crops. Estimated cost $1000.

Application No. 5236 (San Diego County)—Mrs. R. Silva, Box 224 Escondido, Calif., for 0.25 cubic foot per second from Los Cochis Creek tributary to San Diego River to be diverted in Sec. 13, T 15 S, R 1 E, S. B. M. for irrigation and domestic purposes in Sec. 13, T 15 S, R 1 E, S. B. M. (12 acres). Estimated cost $1500.

Application No. 5237 (Alameda County)—Henry Linderman, Sr., c/o Ohm & Raab, 517 E. Market St., Stockton, Calif., for 5.44 cubic feet per second from Kennedy Cut tributary to Old River to be diverted in Sec. 29, T 1 S, R 4 E, M. D. M., for agricultural purposes on 435.8 acres. Estimated cost $8,000.

Application No. 5239 (Lake County)—William A. Forbes, 750 12th Ave., San Francisco, Calif., for 0.56 cubic foot per second from Seigler Creek tributary to Cache Creek to be diverted in Sec. 19, T 12 N, R 7 W, M. D. M., for irrigation and stock watering purposes on 120 acres. Estimated cost $1500.00.

Application No. 5241 (Lake County)—James P. Smith, Kelseyville, Calif., Box 262, for 1.0 cubic foot per second from Cold Creek to be diverted in Sec. 36, T 13 N, R 9 W, M. D. M. for irrigation and domestic purposes on 80 acres.

Application No. 5243 (Mariposa County)—Louise Land Co., La Grande, Calif., for 60,000 acre feet per annum from Chowchilla River tributary to San Joaquin River to be diverted in Sec. 18, T 7 S, R 20 E, M. D. B. & M., for irrigation of 20,000 acres. Estimated cost $400,000.

Application No. 5244 (Sutter County)—D. C. Smith et al, Meridian, Calif., for .150 cubic feet per second from Butte Creek tributary to Sacramento River to be diverted in Sec. 36, T 16 N, R 1 W, M. D. M. for stock watering purposes and irrigation of 8000 acres.

Application No. 5245 (Placer County)—Bank of Italy as Trustee for A. K. Detwiler and Wm. J. D. Lambert, Tahoe City, Calif., for 1 cubic foot per second from unnamed spring tributary to Lake Tahoe to be diverted in Sec. 22, T 15 N, R 16 E, M. D. M., for agricultural and domestic purposes on 80 acres in Sec. 13.

Application No. 5247 (Tuolumne County)—Sierra and San Francisco Power Co., San Francisco, Calif., for 60,000 acre feet per annum from Middle Fork Stanislaus River tributary to San Joaquin River to be diverted in Sec. 11, T 1 N, R 13 E, M. D. M. for irrigation and domestic purposes on 150,000 acres.

Application No. 5248 (San Joaquin County)—Banta-Carbona Irrigation Dist., Tracy, Calif., for 40 cubic feet per second from San Joaquin River tributary to San Francisco Bay to be diverted in Rancho El Pescadero for agricultural and domestic purposes on 18.486 acres. Estimated cost $334,000.

Permits Issued

Among the more important permits to appropriate water issued by the Department of Public Works, Division of Water Rights, California, during the month of October, 1926, were the following:

Permit No. 2635, Application No. 5023 (Inyo County) Issued to Reorganized Silver King Divide Mining Co., Reno, Nevada, October 5, 1926, for 0.03 cubic foot per second from 2 springs in Sec. 1, T 24 S, R 42 E, for mining, milling and domestic purposes in Secs. 35 and 36, T 23 S, R 43 E. Estimated cost $3,500.

Permit No. 2640, Application No. 4995 (Ventura County) Issued to James Erwin, Piru, Calif., October 9, 1926, for .1 cubic foot per second from unnamed creek and spring in Sec. 10, T 4 N, R 19 W, for domestic and irrigation of 7 acres in Sec. 10.

Permit No. 2641, Application No. 5033 (Los Angeles County) Issued to Sara Hedge Stevens, Llano, Calif., October 11, 1926, for 0.075 cubic foot per second from a spring in Sec. 25, T 4 N, R 8 W, for domestic, stock and irrigation of 8 acres in Sec. 25. Estimated cost $1000.

Permit No. 2643, Application No. 5082 (Mendocino County) Issued to Wilfred Bradbreek, Spyreck, Calif., October 13, 1926, for .22 cubic foot per second from Burns Creek in Sec. 36, T 24 N, R 15 W, for irrigation of 20 acres in Sec. 30, T 24 N, R 14 W.

Permit No. 2645, Application No. 5120 (San Joaquin County) Issued to Jack Klein and Sol D. Klein, Stockton, Calif., October 14, 1926, for 4.19 cubic feet per second from Middle River in Sec. 1, T 1 S, R 4 E, for irrigation of 335.4 acres near point of diversion. Estimated cost $3,500.

Permit No. 2646, Application No. 5121 (San Joaquin County) Issued to M. G. Oliveira, Stockton, Calif., October 15, 1926, for 4.7 cubic feet per second from Burnes Cutoff in Sec. 12, T 1 N, R 5 E, for irrigation of 377.6 acres near point of diversion. Estimated cost $6000.

Permit No. 2647, Application No. 5153 (San Joaquin County) Issued to Theodore Lorenzen, Stockton, Calif., October 15, 1926, for 12.34 cubic feet per second from San Joaquin River in Sec. 22, T 2 S, R 6 E, for irrigation of 987.6 acres near point of diversion. Estimated cost $16,000.

Permit No. 2649, Application No. 5160 (Sutter County) Issued to The Commercial Investment Co., Sacramento, Calif., October 18, 1926, for 1.75 cubic feet per second from Sacramento River in Sec. 11, T 11 N, R 2 E, for irrigation of 140.07 acres near point of diversion. Estimated cost $3000.

Permit No. 2651, Application No. 4956 (Butte County) Issued to Mrs. Kate Haack, Oroville, Calif., October 21, 1926, for 3 cubic feet per second from Lateral E-I of Recl. Dist No. 833 Drainage Ditch in Sec. 6, T 17 N, R 2 E, for irrigation of 128 acres of rice in Sec. 6.

Permit No. 2653, Application No. 4904 (Santa Barbara County) Issued to Caleb A. Ensign, Maricopa, Calif., October 22, 1926, for 0.37 cubic foot per second from Eckert Canyon Creek in Sec. 12, T 10 N, R 29 W, for domestic and irrigation of 45 acres in Sec. 7.

Permit No. 2654, Application No. 4104 (San Mateo County) Issued to Islam Redwoods Shrine, San Francisco, Calif., October 22, 1926, for 4.59 cubic feet per second not to exceed 3 cubic feet per second from any one source, from Evans, Slate and Peters Creeks in Secs. 3 and 5, T 8 S, R 3 W, for domestic use and irrigation of 1640 acres near point of diversion. Estimated cost $51,100.

Permit No. 2655, Application No. 5136 (Del Monte County) Issued to C. F. Huffman, Crescent City, Calif., October 25, 1926, for 0.27 cubic foot per second from an unnamed spring in Sec. 35, T 16 N, R 1 W, for domestic and irrigation of 22 acres in Sec. 26.

Permit No. 2657, Application No. 5054 (San Diego County) Issued to C. M. Eichenlaub, San Diego, Calif., October 26, 1926, for 0.12 cubic foot per second from Skye Valley Creek in Sec. 2, T 17 S, R 3 E, for domestic, stock and irrigation of 10 acres near point of diversion. Estimated cost $400.

Permit No. 2658, Application No. 5092 (San Joaquin County) Issued to Edna Gianelli, et al, Stockton, Calif., October 26, 1926, for 15.15 cubic feet per second from Beaver Slough and S. Fork Mokelumne River in Secs. 17 and 18, T 4 N, R 5 E, and Sec. 12, T 4 N, R 4 E, for irrigation of 1212.1 acres near point of diversion. Estimated cost $15,000.

Permit No. 2660, Application No. 4896 (Sacramento County) Issued to E. O. Morse, Elk Grove, Calif., October 30, 1926, for 11.5 cubic feet per second from Burton Slough and Mokelumne River in Secs. 16, 17, 20, 21 and 28, T 5 N, R 5 E, for irrigation of 920.2 acres near point of diversion. Estimated cost $5000.

OREGON

Among the more important applications for permit to appropriate water filed in the office of Rhea Luper, State Engineer of Oregon, from October 9 to November 13, were the following:

F. M. Lockwood of Walla Walla, Washington, covering the appropriation of water from East Br. Mud Creek and Swamp drainage, tributary of Walla Walla River, for mostly winter irrigation and washing out alkali of 35 acres in Umatilla County.

City of Newport, a municipal corporation, of Newport, Oregon, covering the appropriation of water from Big Creek and its tributaries, for Municipal Water Supply, in Lincoln County.

J. G. Jarvis, of Hood River, Oregon, covering the appropriation of water from Seepage water and waste water to Whiskey Creek, tributary of Hood River, for the irrigation of 10 acres in Hood River County.

James Trimble of Hereford, Oregon, covering the appropriation of water from Burnt River, tributary of Snake River, for irrigation of 37 acres in Baker County.

Minette Sentner of Cove, Oregon, covering the appropriation of water from Springs and Swamps, tributary of Mill Creek, for irrigation of 20 acres in Union County.

J. B. Curl, of Port Orford, Oregon, covering the appropriation of water from Bald Mountain Creek, tributary of Elk River, for municipal supply for City of Port Orford, in Curry County, Oregon.

Frank Cook of Turner, Oregon, R. F. D. No. 2, covering the appropriation of water from Cook Creek, tributary of Mill Creek, for irrigation and power, irrigation of 20 acres in Marion County.

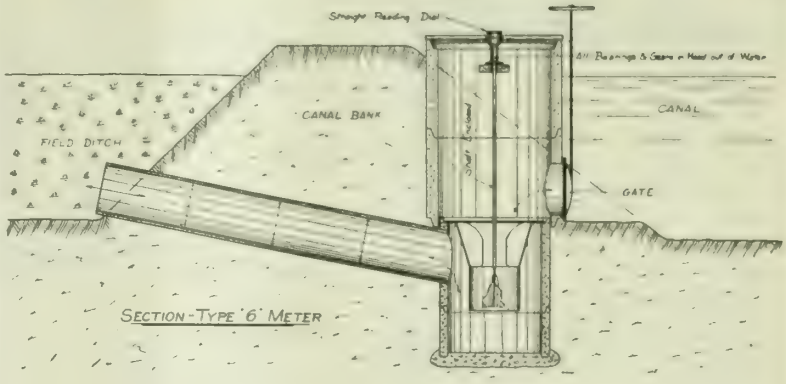
G. H. Lund and Dena Towle, of Cove, Oregon, covering the appropriation of water from waste water raised on the NW ¼ of Sec. 15, T. 3 S, R. 40 E, for the irrigation of twenty acres in Union County.

C. A. Lockwood of Roseburg, Oregon, covering the appropriation of water from North Umpqua River, tributary of Umpqua River, for irrigation of 12 acres in Douglas County.

Earl Bechdolt of Butte Falls, Oregon, covering the appropriation of water from Beaver Dam or Parsnip Creek, tributary of Buck Creek (Middle Fk. Rogue River) for irrigation of 100 acres in Jackson County.

William S. Woodcock of Malheur, Oregon, covering the appropriation of water from Cottonwood Gulch and springs, tributary of

The RELIANCE METER



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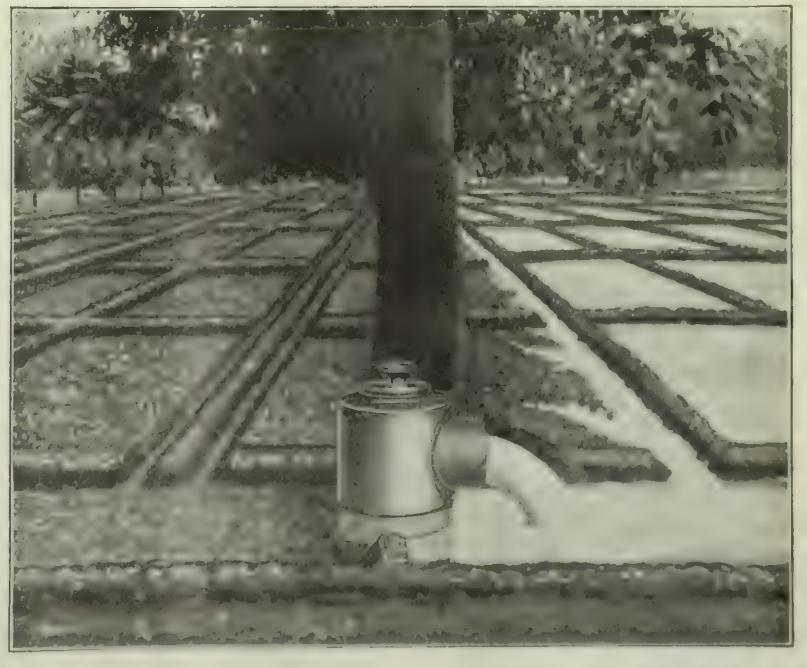

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Willow Creek, for the irrigation of 10 acres in Malheur County.

R. E. Scott of Mitchell, Oregon, covering the appropriation of water from Gable Creek, tributary of Bridge Creek for supplemental irrigation of 98.4 acres during the non-irrigation season in Wheeler County.

The Roseburg Country Club of Roseburg, Oregon, covering the appropriation of water from North Umpqua River, tributary of Umpqua River, for domestic purposes and the irrigation of 104 acres in Douglas County.

Samuel E. Perkins, of Kerby, Oregon, covering the appropriation of water from Mendenhall Creek, tributary of West Fork Illinois River, for the irrigation of 15 acres in Josephine County.

H. F. McCormick, of St. Helens, Oregon, covering the appropriation of water from Milton Creek, tributary of Columbia River, for the irrigation of 72 acres in Columbia County.

Albert Johnson, of Canyon City, Oregon, covering the appropriation of water from Canyon Creek, tributary of John Days River, for the irrigation of 12 acres in Grant County.

Nick Barry, of Adel, Oregon, covering the appropriation of water from a reservoir on Jack Creek, tributary of Guano Lake, for the irrigation of 640 acres in Lake County.

U. S. Reclamation Report Cites New Confidence of Settlers

Adjustment Act Held Responsible for New Spirit of Optimism on Federal Projects; Construction Progress Given

Enactment of the Reclamation Adjustment Act has resulted in a spirit of confidence, optimism, and cooperation among settlers on Federal reclamation projects, according to the annual report of the Commissioner of Reclamation to the Secretary of the Interior.

Summarizing its beneficial effect the report points out that the reclamation projects have been more nearly placed on a strictly business basis than at any time in their history, the threat of having to pay water charges on unproductive land has been taken from settlers, debts which water users did not believe they should be called upon to pay have been wiped out, and time of payment has been extended so that the adverse influence of temporary hard times in agriculture has been overcome.

Boost in Crop Values

The Commissioner's report shows that the total value of crops grown in 1925 on irrigated lands furnished in whole or in part from Government irrigation works was $131,000,000, compared with $110,000,000 in 1924, an increase of $21,000,000. Total payments from water users to the Reclamation Bureau increased from $3,811,600 in 1924 to $4,454,800 during the fiscal year of 1925, a gain of $643,200.

Regarding the engineering activities of the Bureau, the report announced that the Gerber dam on the Klamath project in Oregon-California, and the McKay dam for the irrigation of the greater Umatilla project in Oregon will be completed this year. Construction of the Guernsey dam on the North Platte project in Nebraska-Wyoming was continued during the year and plans were made for the construction of the Stony Gorge dam on the Orland project in California and the Gibson dam on the Sun River project. Contracts for the first unit of the Kittitas division of the Yakima project in Washington have been finished while plans are being consummated for the early commencement of construction of the Vale and Owyhee projects in Oregon. In the absence of convincing evidence of the feasibility of the Baker project in Oregon, nothing has been done toward carrying it out.

Wage Settlement Campaigns

The report announced that an intensive settlement campaign had been made on the Belle Fourche project in South Dakota and the Lower Yellowstone project in Montana-North Dakota. Both of these projects need settlers who will be good farmers. If a considerable acreage of the unoccupied or unirrigated lands on these projects can be settled with the right type of farmers by the beginning of the next irrigation season, it will have placed two Federal reclamation projects on a sound financial footing and pointed the way to similar development on other projects.

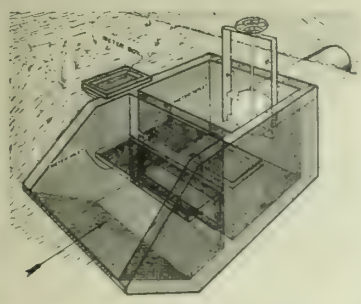
Under an appropriation of $15,000, plans were being made for a preliminary survey of opportunities in the southern States for planned rural community development, a report on which will be made to Congress at the coming session.

Bureau of Reclamation to Test Imperial's Levees in Mexico

Imperial Irrigation District Makes Request Following Query by California Bankers Association

The Federal Bureau of Reclamation has been invited by the Imperial Irrigation District of California to make a survey of the protective levees below the Bee River Dam in the republic of Mexico, the Interior Department announced on Oct. 26.

The invitation was sent to Dr. Elwood Mead, Commissioner of the Reclamation Bureau, in the form of a resolution adopted by the Imperial Valley irrigation organization after the California Bankers Association expressed doubt over whether the levees were of the proper height to avert floods along this river. The district promises to furnish the Reclamation Bureau the necessary



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equipment and party to perform the details of the survey.

Record Crowd Attends Meeting

(*Continued from Page 25*)

large measure, to A. P. Lovell, superintendent of the San Diego water department, who was chairman of the committee on arrangements. Mr. Lovell's committee also gave generous assistance to the exhibitors. Fifty exhibitors in all occupied booths in the convention hall and their displays comprised a complete line of equipment and supplies necessary to the construction and operation of a modern waterworks system.

The election of officers resulted in the choice of S. B. Morris for the chairmanship of the section. Mr. Morris is chief engineer of the Pasadena water department and served as vice chairman of the Section during the past year, and as secretary-treasurer prior to that.

J. J. Ryland of San Jose was elected vice chairman, and Paul Magerstadt of the East Bay Water Company, Oakland, was re-elected secretary. P. Dietrich and John Burt will compose the executive committee for the coming year.

Next year's convention will be held at San Jose, the exact dates to be announced later.

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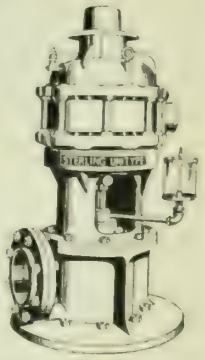

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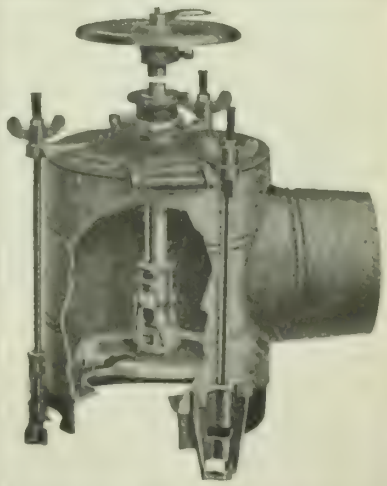
Cures Cement by New Process

(*Continued from Page 53*)

contractor must have idle men on his hands the balance of the day, as it is not practical to hire men for half a day. Next, there is the continuous wetting, either by puddling or covering the whole surface with wet earth. Then there is the question as to whether the shoveling onto the pavement of earth and small rocks does any damage to the surface of the pavement.

"It is impractical for the contractor to clean off a piece of pavement as soon as the curing period is over, so as a rule this earth is left upon the pavement until completion of the project or until a great portion is completed; then it is bladed into wind-rows. The blade, in scraping over the top of the pavement, may damage the newly set crystals, causing the pavement to "dust" on top.

"The wind-rowed earth may either be loaded by machine or hand in trucks, and hauled away to a dumping ground. Then the pavement is thoroughly cleaned and a color coat is applied for the purpose of killing the glare of a white pavement. Frequently before this curing earth is removed it becomes dry, and if traffic is allowed on it, dust blows into homes, upon lawns, shrubbery and so on."



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AMONG OUR CONTRIBUTORS

Editorial Jottings About Current and Forthcoming Feature Articles, Dealing With Practical Problems of Hydraulics, and the Men Who Have Written Them

GEORGE S. HENRY, whose contribution in this issue describes the plan developed by the Vista Irrigation District, in southern California, for a satisfactory settlement of its riddle of water allocation, is a man who brings to the important office of president of an irrigation district a specialized training and experience not generally found in such high

GEORGE S. HENRY

places. Mr. Henry is a graduate of Harvard, where he specialized in hydraulics and irrigation engineering. His early experience was gained in engineering work in Mexico, and he was later associated with his father, the late T. C. Henry, of Denver, in irrigation development in Colorado, Utah, New Mexico and other sections of the Southwest. In 1911 he removed from Colorado to California, where he has been engaged since that time in irrigation and land development and settlement. When the Vista Irrigation District was formed, his wide experience in irrigation district law and practice as well as his knowledge of the technical and financial problems incidental to the successful launching of such a project, fitted him admirably for the post to which he was chosen—that of the district's first president.

FOR MORE than a generation William Mulholland, who describes the proposed Colorado aqueduct, has been a notable figure in waterworks and engineering circles of Southern California. During the forty years that he has been superintendent and chief engineer of the Los Angeles water system he has played an active part in the development of many irrigation and water supply projects. The Owens River aqueduct is perhaps his best known piece of work. For this project he devised the plans and superintended the construction of an aqueduct for conveying a supplementary water supply from the Sierra Nevada Mountains to Los Angeles, a distance of 250 miles, at a cost of $24,500,000. Mr. Mulholland was born in Belfast, Ireland, in 1855. He received his education in Dublin, and was awarded the degree of LL.D. by the University of California.

THE ARTICLE telling of the work in irrigation done by the Washington State College is one of a series in which is being related the significant story of the contributions which the higher institutions of learning in all parts of the West are making to the progress of irrigation knowledge—and, more important, to the application of that knowledge. O. L. Waller, author of the article, is well qualified to summarize the relationship between his college and irrigation in the Northwest. In addition to being vice-president of the institution, and head of its department of civil engineering, he has himself had an important part in the irrigation history of Washington. In 1900, he was appointed expert in irrigation drainage for the United States Department of Agriculture; in 1915, he was chairman of the federal Board of Review named to report to the Secretary of the Interior the condition of federal irrigation projects in the state; he was chairman of the Water Code Commission, appointed by the governor to revise the state's water laws; he was a member of the Columbia Basin Commission, named by the legislature to study the possibility of developing the Columbia plateau through irrigation; and he recently served as a member of the federal board of engineers created to report to the Secretary of the Interior on the feasibility of the Columbia Basin Irrigation project.

DR. CARL WILSON, who writes the article on the Biological Control of Reservoirs, is director of the biological laboratory of the Los Angeles Bureau of Waterworks and Supply. Dr. Wilson

DR. CARL WILSON

has "followed the game" for twenty-five years and for half of that time has been in his present position. Before becoming a member of the Los Angeles Water Department he spent three years with a private waterworks company in Monterey, Mexico, and for a number of years was engaged in private practice.

CHARLES H. LEE is not unfamiliar to readers of MODERN IRRIGATION. He is the author of the "Water Survey of San Francisco District," published in our October issue. Mr. Lee is a consulting engineer in private practice in San Francisco, and specializes in water supply and development. The plan he proposes in this issue for determining the future water requirements of metropolitan areas will be discussed further next month.

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For 12 Months: $2.00; Single Copies: 20 cents.

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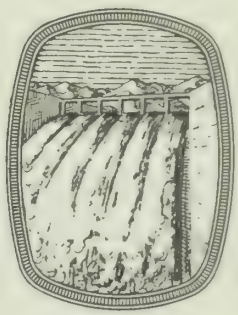
"Western Waterworks" Begins on Page 25

MAJOR C. R. OLBERG

Who, in his capacity of engineer in the U. S. Indian Service, designed the Coolidge Multiple Dome Dam on the San Carlos, Arizona, irrigation project. Major Olberg has to his credit not only the accomplishment of the preliminary work, including the design, of the Coolidge Dam, but also the construction of the Ashurst-Hayden Dam, the design and part of the construction of the Sacaton Dam and Bridge, both in Arizona, and is in charge of the San Carlos project in that state. He has been in the Indian Service for 26 years.

MODERN Irrigation
The Magazine of Applied Hydraulics



Volume II DECEMBER, 1926 Number 12

The Progress *of* Irrigation

A TENTATIVE ten-year construction program for Federal reclamation with total estimated expenditures amounting to $97,514,000 that will result in the completion of all existing Government projects, has been proposed by the Interior Department.

The program contemplates construction work on 22 unfinished projects in 17 Western States with annual expenditures averaging between $8,446,000 and $10,826,000, a sum exceeding the probable average annual income of the Reclamation Fund by about $1,000,000. If adopted, the program will preclude the undertaking of any new projects by the Government during this period.

Annual construction work to carry out the proposed program provides for the expenditure of $10,826,000 in 1928; $10,239,000 in 1929; $9,118,000 in 1930; $9,180,000 in 1931; $8,597,000 in 1932; $8,450,000 in 1933; $8,521,000 in 1934; $8,730,000 in 1935; $8,584,000 in 1936; $8,446,000 in 1937 with an additional $6,823,000 to be expended thereafter. An outline of the apportionment by projects of these annual expenditures under the program follows:

A total of $1,291,000 has been apportioned to complete the distribution, drainage and power systems of the Yuma, Arizona-California project. Of this amount it is proposed to expend $35,000 in 1928, $60,000 in 1929, $55,000 in 1930, $550,000 in 1931 and $591,000 in 1932. This project under the program will be completed in 1932.

A total of $727,000 will be used to construct the Stony Gorge reservoir and complete lateral canal extensions and linings on the Orland, California, project, the proposed expenditures consisting of $605,000 in 1928, $32,000 in 1929, $30,000 in 1930, $30,000 in 1931, and $30,000 in 1932. This project under the program will be completed in 1932.

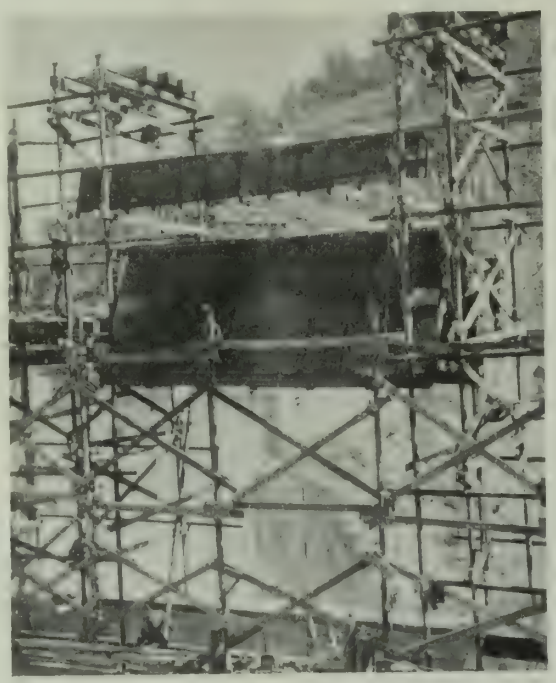
The sum of $136,000 has been apportioned to complete distribution and drainage systems of the Grand Valley, Colorado, project, divided as follows: $30,000 in 1928, $30,000 in 1929, $30,000 in 1930, $30,000 in 1931, and $16,000 in 1932. This project under the program will be completed in 1932.

An aggregate of $500,000 for drainage system on the Uncompahgre, Colorado, project has been proposed, $300,000 to be expended in 1932 and $200,000 in 1933. Under the program this project will be completed in 1933.

"Western Waterworks" Begins on Page 25

A total of $6,334,000 will be spent for main canal betterments, and drainage on the Arrowrock and Payette divisions of the Boise, Idaho, project, distributed as follows: $116,000 in 1928, $84,000 in 1929, $50,000 in 1930, $1,000,000 in 1932, $1,500,000 in 1933, $1,500,000 in 1934, $1,500,000 in 1935, and $584,000 in 1936. This project under the program will be completed in 1936.

A total of $8,423,000 has been apportioned to complete American Falls reservoir, American Falls power development, Minidoka power development, south side pumping division drainage and north side pumping unit at Minidoka, Idaho. This proposed expenditure is divided as follows: $1,583,000 in 1928, $1,000,000 in 1930, $2,671,000 in 1931, $1,000,000 in 1932, $1,250,000 in 1933, and $919,000 in 1934. This project under the program will be completed in 1934.



Lowering drumgate A-2, Melones Dam, Oakdale and South San Joaquin Irrigation Districts, California.

A total of $181,000 will be spent to complete the St. Mary Canal and Sherburne Lakes reservoirs and canal and lateral system at Milk River, Montana, with $17,000 expended in 1928, $40,000 in 1929, $40,000 in 1930, $49,000 in 1931, and $35,000 in 1932. Under the program this project will be completed in 1932.

The sum of $3,653,000 will be used for Gibson reservoir, Fort Shaw distribution system, north side distribution system and north side drainage at Sun River, Mont., with $1,037,000 expended in 1928, $1,165,000 in 1929, $500,000 in 1935, $500,000 in 1936 and $451,000 in 1937. This project under the program will be completed in 1937.

On the Lower Yellowstone, Montana-North Dakota, $460,000 has been apportioned to complete drainage system divided as follows: $100,000 in 1928, $180,000 in 1929, $180,000 in 1930. This project under the program will be completed in 1930.

A total of $707,000 will be set aside to complete Guernsey reservoir, power development, distribution and drainage systems on the Interstate and Fort Laramie division of the North Platte, Nebraska-Wyoming project, the expenditures to be divided as follows: $450,000 in 1928, $147,000 in 1929, $75,000 in 1930, and $35,000 in 1931. Under the program this project will be completed in 1931.

At Newlands, Nevada, $1,164,000 will be spent for Truckee storage, canal construction, a power system and Carson division distributing system of which $64,000 is to be expended in 1928, $50,000 in 1929, $50,000 in 1930, $500,000 in 1934 and $500,000 in 1935. This project under the program will be completed in 1935.

At Carlsbad, New Mexico, $1,001,000 has been voted for McMillan reservoir claims and for Avalon water storage divided as follows: $501,000 in 1929 and $500,000 in 1930, thus completing this project in that year.

A total of $590,000 has been apportioned to complete the distribution and drainage system of the Rio Grande, New Mexico-Texas project divided as follows: $400,000 in 1928 and $190,000 in 1929. This project under the program will be completed in 1929.

At Owyhee, Oregon, $17,714,000 will be spent to construct storage, canal, and drainage systems as follows: $2,000,000 in 1928, $3,000,000 in 1929, $3,000,000 in 1930, $3,000,000 in 1931, $3,000,000 in 1932, $3,000,000 in 1933, and $714,000 in 1934, thus completing the project in 1934.

A total of $3,115,000 for storage, canal, drainage, and distribution system on the Vale, Oregon, project, will be divided as follows: $750,000 in 1928, $750,000 in 1929, $750,000 in 1930, and $865,000 in 1931. This project under the program will be completed in 1931.

The Klamath, Oregon-California, project will receive $1,831,000 to complete Tule Lake distributing and drainage systems, Langell Valley (Clear Lake) and Langell Valley (Gerber division). Expenditure of this sum is divided as follows: $124,000 in 1928, $500,000 in 1932, $500,000 in 1933, $477,000 in 1934, and

(*Continued on Page 37*)

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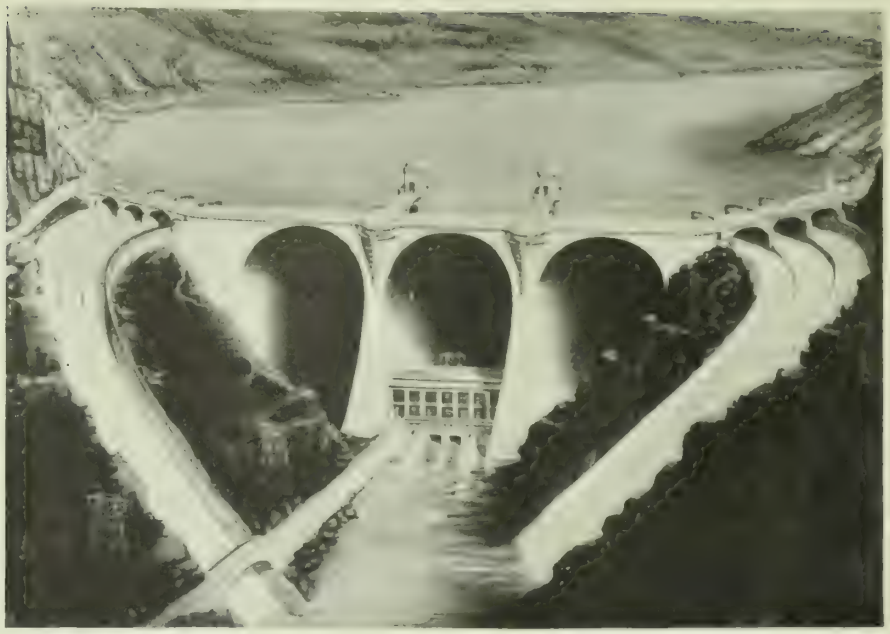

How the Coolidge Dam will look when completed. Contract for the construction of the dam, the first multiple dome type in the world, has been awarded to the Atkinson-Spicer Company, Los Angeles.

Engineering Aspects of Coolidge Dam Excite Interest of Hydraulic World

Multiple Dome Structure of San Carlos Project of Arizona Will be First of Its Kind in World

THE engineering world has taken great interest in the new government reclamation project, the Coolidge Dam, the contract for which has just been given to the Atkinson-Spicer Company of Los Angeles. The dam was designed by Major C. R. Olberg, engineer on the United States Indian Service, and is known as the Multiple-Dome Type. It will be the first of its kind ever built.

Major C. R. Olberg is a well known hydraulic engineer, and has been in the government service since his graduation from George Washington University in 1900. He was in charge of the preliminary work, including design of the Roosevelt Dam; constructed the Ashurst-Hayden Dam in Arizona; was in charge of the design and part of the construction of the Sacaton Dam and Bridge in Arizona; and is now responsible for the development of this new work, the San Carlos Project of Arizona.

Local History

Colonel J. H. McClintock, former state historian of Arizona, has given some interesting information in regard to the former occupants of the San Carlos area, and in a recent article stated:

"The area to be reclaimed, named after the ruins of the prehistoric community houses, was farmed, a thousand years ago, by a people who built canals from the Gila and who were possessed of a culture similar to that of the Pueblo tribes of today. Their homes were ruins when seen, about 1694, by Padre Kino, the first white man to write of the region, while the Pimas tell that when their forefathers came the ruins were even then ruins. The Pimas cleaned out some of the ancient ditches and were farming when the Spaniards arrived, raising corn, cotton, beans, and squash. Being land owners, they were conservative among the Indians and they joyously helped the white man in his campaign against the Apache Ishmaelites of the hills.

"About 1870, the white man began diversion of water around Florence, and a few years later more waters of the Gila were taken out around Safford, farther up the stream. The minimum flow of the stream thus became appropriated, to the injury of the Indians, though it is known that their summer supply had always been limited and often non-existent. Year after year attempts were made to secure appropriations for the benefit of the Pimas, whose story of friendship for the whites has had frequent repetition."

The plan of giving assistance to the Pima Indians has been contemplated by the Indian Office for a great many years, but conditions prevented the materialization. It was for this reason that Edgar B. Merritt, assistant commissioner of Indian Affairs, was instrumental in preventing the granting of permit to a large transcontinental railroad to build within the area to be used by the flood waters, because he could foresee that if the railroad once established its route, it would be very expensive to have them make a change.

The dam, designated the Coolidge Dam by Congress in honor of the President, will impound water for the irrigation of some 100,000 acres of land, constituting the San Carlos Irrigation Project, in Southern Arizona. This project is being constructed under the direction of the U. S. Indian Irrigation Service, since the irrigable land is equally divided between the Pima Indians of the Gila River Indian Reservation and the white owners of lands adjacent to the towns of Florence and Casa Grande, Pinal County, Arizona. As indicated on the accompanying map, the project lands are located immediately south of the Salt River project, one of the most prosperous of those constructed by the U. S. Reclamation Bureau, and since the climatic and other physical conditions are practically the same, it is anticipated that the San Carlos project should enjoy a similar success.

The Dam Site

The site of the Coolidge Dam is located about 100 miles above lands to be irrigated, at the entrance to the Box Canyon of the Gila River, some 35 miles southeast of Globe, Arizona. San Carlos, from which the project derives its name, is located on the Southern Pacific Railroad at the confluence of the Gila and San Carlos Rivers about nine miles above the dam site.

The discharge of the Gila at the dam site varies from a few second feet during the dry season to about 92,000 second feet during maximum flood, the mean annual run off being about 400,000 acre feet. A study of the river discharge records for the past 35 years indicates that a dam rising 220 feet above the river bed, provided with floating spillway gates, was best adapted to local

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conditions. The resulting reservoir, having an approximate capacity of about 1,200,000 acre feet, will form a lake extending up the valleys of the Gila and San Carlos Rivers a distance of about 25 miles, with a maximum width of about 2 miles. The great size of the storage reservoir and the comparatively large ratio of the storage volume to mean annual run off combine in rendering the accumulation of silt relatively unimportant, thereby relegating the silt problem to the distant future, and practically assuring an annual draft of 320,000 acre feet of water over a very long period.

The elevation of the river bed at the dam site is 2,313, U. S. G. S. datum, while the width of the canyon at the same point is about 300 feet, widening to about 600 feet at the crest of the dam. Borings at the dam site indicate that the maximum depth to bed rock is 23 feet, and it is assumed that it will be necessary to excavate ten feet into this rock to secure adequate foundations. The borings and exposed rock on the canyon sides indicate that the bed rock is hard quartzite. Suitable sand, gravel and rock are available at the site for the construction of the dam.

Developments of Multiple Dome

The building of the Coolidge dam required the removal of some 14 miles of railroad from the reservoir basin, involving some very heavy construction, and since the amount available for the dam including all charges was limited by Congress to $5,500,000, it was necessary to exercise the greatest economy to stay within the amount authorized.

Several types of dams were investigated for the Coolidge site, to determine the most economic type, and in the effort to overcome objections inherent respectively in the variable radius and multiple arch dams, the multiple dome type was developed.

This type consists of a series of egg-shaped domes supported by intermediate buttresses and the canyon walls. The development of this type was due to the apparent discovery during the course of the analytical investigation that the desirable relation respecting minimum stresses and economy of material, and the rise and span of the arch elements resisting the water pressure, formed an egg-shaped dome, the smaller end resting on the foundation and the larger forming part of the crest of the dam.

Resembles Multiple Arch Type

Superficially the dam resembles the multiple arch type since there is no distinct line of demarcation along the spring line of the arch elements forming the dome, which lends to the front elevation of the dam the appearance of a series of barreled arches. Actually very little similarity exists between the two types except that both are inclined upstream to take advantage of the water pressure and both employ buttresses in the design. Due to the egg shape of the dome, the span of the arch elements diminishes as the depth of the arch below the water surface increases, and the rear of the buttresses is flared out to support the arches. For this reason the span of the arch at the base of the dam is comparatively short and greater stability is given to the buttress.

On account of the arch and wedge action at the base due to the shape, cantilever action is virtually eliminated. At the crest, the dome shape is adapted to the use of the dam as a bridge or roadway. Each dome is supported on a continuous surface extending along the buttress or canyon walls and the foundation.

Extrados Is Surface of Revolution

The extrados, or outer surface of the dome, is a surface of revolution, since it can be generated by revolving the trace of the extrados on a vertical plane through the center of the dome and normal to the dam, around a certain inclined axis through an arc varying from 180° at the base to about 80° at the crest. Hence the trace of the extrados on the plane normal to the inclined axis is the arc of a circle with a central angle varying from 80° to 180°. The inner surface or intrados of the dome cannot be generaated in this manner owing to the necessity of increasing the thickness of the arch elements at the haunches in order to satisfy stress requirements and for this reason the trace of the intrados on the plane normal to the inclined axis is a three-centered arch. In each dome the upper section at the crest and the intrados at the heel are parts of true spherical domes.

While the dome shape undoubtedly contributes to the strength and stability of a structure, on account of the limitations of the methods of analysis available each dome is figured as a series of inclined arch elements and the beneficial effect of the dome action is not included in the calculations.

Hools' Method of Arch Analysis based on the elastic theory was used in the design since it appeared after investigation to be more rigid analytically and better adapted to the particular type and loading of the arches than other methods.

The arches are designed to have little or no tension in the concrete and to keep the compressive stresses within reasonable limits, including the effect of rib shortening and an appropriate temperature variation.

The desired stress conditions were secured by an appropriate relation of the rise of the arch to the span, by increasing the thickness of the arches as the depth increased and by increasing the thickness of the arches at the haunches. All the domes forming the dam are symmetrical, hence the transverse stresses due to arch action are balanced and carried to the canyon walls.

The buttress stresses are calculated by the monolithic method considering the domes and buttresses acting together. They were also analyzed by a modification of Cain's method as worked out by F. A. Noetzli whereby the directions and intensity of the principal stresses were determined.

Maximum Height 250 Feet

In the design of the multiple dome dam for the Coolidge site three domes and two intermediate buttresses were employed. The maximum height of the dam is 250 feet and it rises 220 feet above the stream bed. The length of the dam or canyon width at the base is about 300 feet while the distance along the crest is 580 feet exclusive of spillways. The spillways are each 150 feet in width. The distance from the rear of the dome along the base of the dam to the toe of the buttress is 286 feet. The buttresses are spaced 180 feet on centers and on the downstream side vary from 60 feet in thickness at the base to 24 feet at the narrowest section which occurs immediately below the spring of the arches forming the bridge. Their thickness at the rear at the base of the dam where they merge into the domes is 110 feet. The clear span of the arch elements forming the dome varies from 70 feet at the heel to a maximum of 150 feet at the "shoulder" of the dome while the thickness of the arches at the crown varies from four feet at the crest to 21 feet at the river bed.

The maximum compressive stress in the arches is 586 pounds per square inch including stresses due to rib shortening and to a temperature variation of 70 degrees F. at the crest, diminishing to 30 degrees F. at the base, and in the buttresses the compressive stress is about 400 pounds per square inch. The compressive stream due to the load alone in the arches is 375 pounds per square inch and with load and rib shortening excluding temperature, 500 pounds. The stress based on the cylinder formula is 370 pounds. There are no tension stresses in the base of the buttress; the compression stresses vary from 18 pounds at the heel to 311 pounds at the toe. The tension stresses in the arches are negligible when the reservoir is full, but when the reservoir is empty some tension develops due to temperature. This

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Highest Multiple Arch Dam in World to be Located Near Phoenix, Arizona

Lake Pleasant Structure Will Rise Total of 250 Feet from Bed Rock

THE LAKE PLEASANT Dam, located near Phoenix, Arizona, and now under construction for the Maricopa county municipal water conservation district No. 1, across the Agua Fria at the site formerly known as Frog Tanks, when completed, will be the highest multiple arch dam in the world. From stream bed to parapet it will rise 170 feet, and below stream it will sink, in the deepest part of the subterranean channel, another 80 feet to bed rock, making a total height of 250 feet.

The second highest multiple arch dam in the United States, known as the Littlerock, was recently completed at Palmdale, in Los Angeles county, California, by J. G. Tripp, the superintendent of construction in charge here for Carl Pleasant, the contractor. It rises 170 feet above stream bed and is 725 feet long, as against 1975 feet of length across the crest of the Lake Pleasant dam.

Built for Irrigation

The duty of the dam is to impound 173,500 acre feet of water in a lake eight miles long and two miles wide for the irrigation of approximately 40,000 acres of land owned by the Beardsley Land and Investment company on the west bank of the Agua Fria river. The average annual discharge of the river, as measured over a period of 15 years, is 254-000 acre feet, of which it is estimated that 140,000 acre feet will be diverted for irrigation. The remainder will waste into the spillway, at times of high floods.

Twice in its known history, the river has risen to a peak discharge of more than 100,000 second feet, but the spillway gates will have a discharge capacity of 150,000 second feet. The plans call for 29 of them, each 23 feet wide by 16 feet high, set across a natural overflow channel situated about 750 feet northwest of the west end of the dam.

Economically Designed

No wastage is contemplated until the water behind the dam rises to a level within one foot from the parapet. Thus the maximum storage capacity of the dam will always be realized as nearly as possible or, to put it another way, the money invested in the dam will be earning the greatest possible amount. The dam, that is, was designed to do a maximum amount of work for a minimum of material and investment.

A multiple arch dam may be described as one relying for its strength, not on sheer mass and weight, but on the structural principles which enable an arch to absorb thrust on its crown and distribute overhead pressure through its piers and haunches to their supporting buttresses, bedded in the solid rock of the bottommost foundations.

The crown of the arch bulges upstream and slopes backward on its upstream face. The piers and haunches lie in the river bed, pointing down stream. The buttresses lie across the stream, and in turn transmit the stresses delivered to them into the natural containing walls of the river. The economy of materials thus effected more than offsets the greater difficulties of construction and the very much greater amount of carpenter work required to build forms.

Engineering Features

The spillway of the Lake Pleasant dam wastes into a second lake below the main storage dam, backed up against it by a diversion dam one and one-quarter miles farther downstream. When there is no wastage through the spillway, the impounded water behind the main dam is discharged through a six-foot valve into a 66-inch steel penstock 200 feet long and out again through a regulating needle-valve into the natural channel of the river. Two other outlets of the same diameter will be installed, for future power use.

Auxiliary Division Dam

The diversion dam, of rubble masonry and gravity type, will back up the water behind it 10 feet against the main dam above. Its function is to recapture and save for irrigation use any water employed in the generation of power or passed through the main dam via the penstock and regulator valve. Out of this second lake opens the main irrigation canal, on the east side of the river, with a carrying capacity of 500 second feet.

Four miles downstream the canal crosses the river to the west shore in a metal flume supported by timber trestles continuing for another eight miles to the

(Continued on Page 36)

Facts Regarding Building of New Lake Pleasant Dam

Following are the principal financial and physical facts underlying the construction of the new Lake Pleasant irrigation and power dam across the Agua Fria river at the Frog Tanks site:

Amount of money available for completion of entire project	$ 3,325,000
Date on which proceeds of bond issue became available	March 11,1926
Storage capacity of dam, in acre feet	173,500
Amount of power to be generated annually in k. w. h.	23,000,000
Acres of land to be irrigated	40,000
January flow of river (maximum month) in acre feet	701,000
Maximum flood flow, in second feet	105,000
Minimum recorded flow, in second feet	0.60
Delivery capacity of diversion canal, in second feet	500
Length of main diversion canal, in miles	35
Aggregate length of lateral canals, in miles	60
Maximum height of main dam from bedrock, in linear feet	250
Maximum depth from stream bed to bedrock, in linear feet	80
Thickness of dam at bottom of longest buttress, in linear feet	253
Length of dam proper across crest, in linear feet	1,975
Length of spillway, approximate, in linear feet	750
Discharge capacity of spillway, through 30 gates, second feet	150,000
Bulk of dam, in cubic yards of concrete	75,000
Number sacks of cement used in mixing concrete	500,000
Weight of reinforcing steel used, in tons	1,200
Amount of excavation from river bed, in cubic yards	80,000
Amount of excavation for spillway, in cubic yards	30,000
Amount of excavation for masonry diversion dam	1,600
Amount of excavation for canal and laterals, in cubic yards	1,700,000
Total excavation for main dam and spillway, in cubic yards	115,000
Grand total of all excavation, in cubic yards	1,900,000

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MEN AND THINGS THAT PLAYED A BIG PART IN THE MELONES DAM

UPPER RIGHT: Power house now under construction. UPPER LEFT: From left to right—R. E. Riley, associate chief engineer, Pacific Gas and Electric Company; P. M. Downing, vice president and chief engineer, Pacific Gas and Electric Company; O. W. Peterson, engineer in charge of Pacific Gas and Electric Company power project, and R. E. Hartley, chief engineer of Melones project. CENTER GROUP: From left to right—H. L. Leventon, assistant superintendent in charge of construction; G. K. Parker, superintendent in charge of construction; C. J. Mathews, president and Ferd Bassler, secretary of Mathews Construction Company. PORTRAIT, LEFT: A. J. Wiley, who designed the dam. Other photographs show interesting features of construction: the height of dam wall, showing roller gates, closed, at the top; a close-up of one of the roller gates, said to be the largest gate of the kind ever made; discharge pipes through which water flows when not going into power house, and detail of trestle work. Concrete was carried from the hillside by gravity, and hauled across the dam in cars over trestle work raised as each section was completed.

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THE MELONES DAM, WHICH WAS DEDICATED ON ARMISTICE DAY, 1926, MARKING THE HAPPY END OF A LONG STRUGGLE OVER CONFLICTING WATER RIGHTS

Melones Dam Completion Ends War Between Districts and Power Companies

Financial and Construction Details of Project Concluded November 11 Make Absorbing Story of How Co-operation Has Succeeded Enmity

By LOUIS MEYER

NOVEMBER ELEVENTH was a date well chosen for the dedication of the Melones reservoir by the Oakdale and South San Joaquin Irrigation Districts, for as Armistice Day of 1926 marked the end of the World War eight years before, so the completion of the big dam meant the finish of years of conflict between the farmers and the power companies, each claiming rights upon the Stanislaus River, in Northern California.

The Oakdale and the South San Joaquin Irrigation districts succeeded to water rights which were among the earliest in California, the old San Joaquin Valley and Canal Company and the Stanislaus Consolidated Water & Power Company (known as the Tulloch system) acquiring the water rights, but not the electric system, seventeen years ago.

Until nearly eight years ago, there was a continued difference of opinion between the irrigation districts and the Sierra & San Francisco Power Company, which took over the electric system belonging to Tulloch, and which built its own reservoirs in the mountains above Sonora for generating power. In 1918 the first step in co-operation was taken, when the districts agreed to buy the stored water owned by the power company at seventy-five cents per acre foot, per annum.

Today this co-operation is carried to its logical conclusion, the dedication of the dam last November marking the end of the fight over water rights on the Stanislaus, and ushering in a new era of development in the irrigation districts affected.

Novel Financial Arrangements

The contract signed two years ago on the one hand by the Sierra & San Francisco Power Company and the Pacific Gas & Electric Company to whom the Sierra system had been leased, and on the other hand by the Oakdale and South San Joaquin irrigation districts, provided in brief that the two districts should build a dam at Melones reservoir, to cost $2,200,000, and to hold 112,000 acre feet of water, and that the power companies should build a power plant to cost $2,500,000, a mile below the dam site.

Under the agreement the power companies are to have the use of the stored water for conversion into electric energy, and are to reimburse the districts for the amounts expended in construction of the dam, both interest and principal, through payments over a period of forty years.

In substance the farmers receive the water required for late irrigation without cost, other than lending their credit for construction of the dam.

When the bond issue was submitted to the voters the directors promised that the additional storage water would not cost them a cent, and that their tax rate would not be increased, because of the favorable agreement with the power companies. This promise has been kept —even in the face of delay in completion of the big dam.

Difficulties Overcome

Like all irrigation districts, the Oakdale and South San Joaquin have had their trials and tribulations. The seventeen years since organization have been years of struggle. But the districts have never defaulted in their interest, and they have never assumed an obligation that they were unable to carry out.

The average citizen is always more or less suspicious of corporations, and the farmers in the two districts have in the past shared in the general disposition to doubt the good intentions of the power

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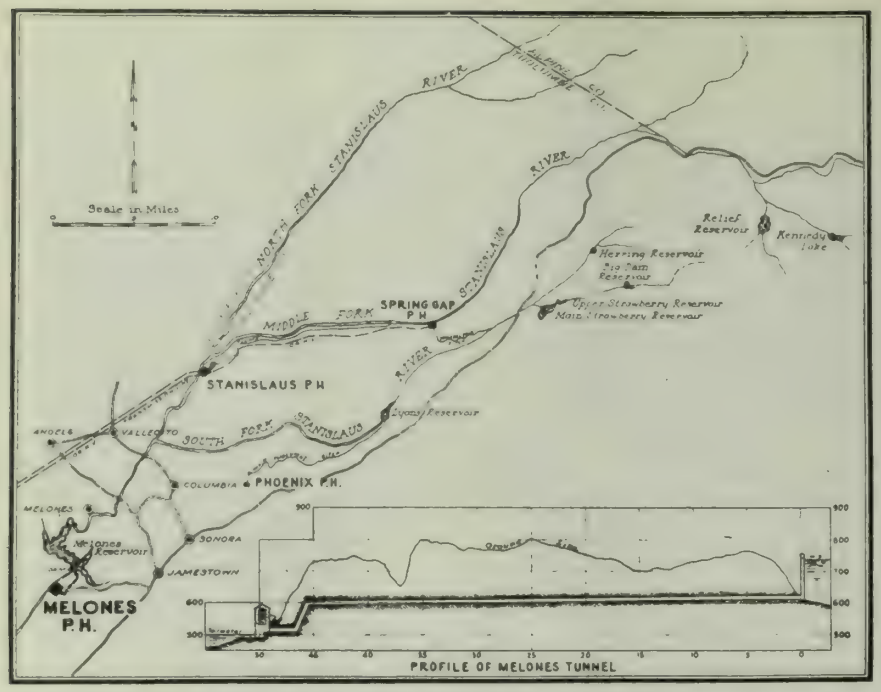

companies. For many years there was a condition somewhat resembling an armed neutrality between the irrigation districts and the old Sierra & San Francisco Power Company over their respective rights upon the Stanislaus river.

The question of the priority of the districts' water rights was always a source of trouble. Although the farmers had first rights to the natural flow of the river, they contended that the water stored by the power company also belonged to them, and were fearful at times that they were being deprived of some of the natural flow of the stream as well through its being impounded in the Sierra reservoirs.

After years of rather acrimonious discussion, the districts finally agreed to recognize the ownership by the power company of the stored water. Then followed a contract by which the farmers paid seventy-five cents per acre foot for the water reelased for their use, as has been described.

What the Contract Provides

It was natural, then, when finally the directors obtained from the Sierra & San Francisco Power Company and the Pacific Gas & Electric Company an agreement by which these corporations would in turn pay the districts, practically at the rate of $1.25 per acre foot, for the water to be impounded at Melones reservoir, that opposition arose—it seemed too good to be true.

In the meantime the irrigation districts had refused, by a heavy majority of votes, a proposition for the purchase of the dam site alone from the Calaveras Copper Company for $125,000. The districts were not then ready to go ahead with storage development—they saw no means of financing expensive reservoirs.

So the contract, which after months and months of negotiations, was signed and sealed and which needed only the approval of the voters at a bond election, was far better than the ranchers had reason to expect. Storage had always meant to them additional taxation —and they had suffered already from excessive taxation, since the war. They read and re-read the proposed contract—meanwhile listening to an aggressive minority demanding that the districts develop their own power and actively fighting the proposed bond issue of $2,-000,000.

The majority of the land holders, however, sensing the fact that they had no market for the power aside from the power companies' offer, and doubting the wisdom of embarking in enterprises outside of irrigation, approved the bonds by a 26 to 1 vote in the Oakdale district, and 3 to 1 in South San Joaquin Irrigation district.

This contract marked an entirely new relationship between farmers and power interests—partners in a joint, commonsense enterprise from which both might benefit.

Both use water—stored water—and it had occurred to them that the expenditure of two millions of dollars when one million would suffice, was foolish and unnecessary.

The terms of the contract are exceedingly plain. They provide that the districts shall build the dam, at an estimated cost of $2,200,000, and that the power companies shall repay them for their expenditures a total of $5,175,000, on a basis of $1.25 per acre foot. This sum, paid over a term of forty years, pays both interest and principal of the bonds.

The districts agreed to vote the needed bonds, which was done May 18, 1925.

The districts agreed to build a reservoir to impound 112,500 acre feet of water, which has been done. They agreed further to provide rights-of-way and a site for a power house to be built by the Sierra & San Francisco Power Company, upon which the power companies agreed to construct a power plant with a maximum capacity of 30,000 kilowatts. Construction is now under way on this power house.

From March 1 to October 31 of each calendar year the districts have exclusive control of the reservoir and water therein, and from November 1 to March 1, the power companies control the reservoir, it being agreed that at no time shall the draft upon the reservoir exceed 1700 cubic feet per second (the maximum requirements of the districts); the power companies agreeing also to permit the storage of 36,000 acre-feet prior to March 1, at Woodward reservoir of the South San Joaquin district.

In addition, the power companies agree to release, for the use of the districts, and without charge, any waters they may store in reservoirs already constructed or hereafter to be built upon the Stanislaus river.

More Storage Available

By virtue of this clause the districts secure, in addition to the 112,000 acre

(*Continued on Page 22*)

R. E. HARTLEY
of Oakdale, Calif., chief engineer of the Melones Project.

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Water Service Extension in the Vista Irrigation District—a Business Solution

By GEORGE S. HENRY
Former President Vista Irrigation District

THE territory served by the water system of the Vista Irrigation District in Northern San Diego County is generally rolling. Climatic conditions and other factors favor the subdivision and settlement of exceedingly small acreages with a consequent eventual dense rural population. The ultimate development will be for citrus, avocado, sub-tropicals, etc., with a large percentage of off-season and winter vegetables during the first years.

The plans for primary construction contemplated the distribution of water to the high point of each 40-acre tract only throughout the district, and this water service was completed on schedule. The board of directors early realized that an opportunity existed in the district for the exercise of business foresight coupled with business methods, in speeding up the transition from a sparsely settled and generally undeveloped section, such as comprise most irrigation projects, to a going concern, promptly utilizing its water resources and developing its economic opportunities through successful and competent colonization. The necessity was very apparent—the means afforded by statutory handicaps not so very clear. After a thorough study of the type of future development likely to take place here and as the greatest single aid, the board devised a plan to extend water service to ten-acre tracts as will be detailed later.

Board's Proposal

It was apparent that good business and proper regard for economy demanded a progressive extension of this 10-acre service, on an orderly plan in step with development needs. A fortunate and somewhat unusual cash saving made in the original construction, plus a substantial reserve in bonds set up at the time construction bonds were voted, provided an ample fund with which to finance the program. A circular letter was addressed to each land owner within the district by the board proposing briefly as follows:

That the District will build such necessary extensions to its system of laterals that water may be delivered to each tract of ten or more acres of irrigable land within said District, the owners of which tracts will comply with the following necessary regulations:

First: If such extension is made during the calendar year 1926, the owner of such tract or tracts shall pay into the treasury of said District the difference between the estimated cost of such extension and an amount equivalent to fifteen dollars ($15.00) per acre for each irrigable acre owned by the owner so applying.

Second: If such extension is made during the calendar year 1927, the owner of such tract or tracts shall pay into the treasury of said District the difference between the estimated cost of such extension and an amount equivalent to eleven dollars ($11.00) per acre for each irrigable acre owned by the owner so applying.

Third: If such extension is made during the calendar year 1928, the owner of such tract or tracts shall pay into the treasury of said District the difference between the estimated cost of such extension and an amount equivalent to seven and 50-100 dollars ($7.50) per acre for each irrigable acre owned by the owner so applying.

Fourth: Each owner so applying for such extensions shall grant to the District easements and rights of way for the laying of such proposed extensions. All laterals or pipe lines so extended under this proposal shall be the property of the Vista Irrigation District.

Fifth: Each owner so applying for such proposed extensions must either have already expended or agree to the satisfaction of the Board that he will expend in improvements upon the land to be served an amount equivalent to fifteen dollars ($15.00) per irrigable acre. The term "improvements" as used in this paragraph shall be construed as meaning leveling of the land or preparing the same for irrigation or planting or proper preparation and cultivation of the soil and the planting of trees and for the laying out of pipe lines or distribution lines, or such other improvements as render the land to be served susceptible of beneficial irrigation and utilization of irrigation waters, or such term shall be construed to mean the subdivision and platting of said land and filing of said plat of record and the approval thereof by the County Engineer and Board of Supervisors of San Diego County, as provided by law, together with necessary and requisite laying out and construction of roads and highways. The owners of land within said District shall have the option of the manner of expenditures for improvements as herein specified. The erection of buildings upon the land shall not be considered as improvements within the meaning of this paragraph.

Sixth: The laying out and construction of all such laterals and extensions shall be done by the District and shall be under the direction of the Engineer of the Vista Irrigation District and shall be laid out in such manner as said Engineer shall deem for the best interests of the land and of the District.

Seventh: In case the expenditures for improvements shall not have been made prior to the application for such extension the owner so applying shall enter into an agreement satisfactory to the Board of Directors that such expenditures will be made within one (1) year from the date of such application, which agreement shall provide that in case of the failure to make such expenditures for such improvements as contemplated by this resolution, and to the satisfaction of the Board of Directors of this District or its Engineer, that the owner of said land shall forthwith pay into the Treasury of the District the amount expended by the District in the construction of such extension, and that the District shall have a lien upon the property so to be served by such extension for the repayment of such money.

Eighth: Before commencing the work of construction of such proposed extensions, the owner so applying shall deposit with the Treasurer of said District a sum sufficient to cover the amount to be contributed by him toward such construction, the amount of such deposit to be determined by the Engineer of the District. Upon the completion of such construction, any surplus over and above the amount to be contributed by such owner remaining in the hands of the Treasurer shall be forthwith returned to such owner

As definitely determined by the Board, extensions of pipe lines to less than 10 acre tracts of irrigable land cannot be made by the District. Where owners of less than ten acres desire extensions, it is suggested that they attempt to secure the cooperation of adjoining neighbors, or ask the Manager of the District for advice in the matter.

Prior to inaugurating this novel program, a test case was prepared and tried in the Superior Court of San Diego County, California, before Judge Cary who affirmed the legality of the board's action.

Plan Is Succeeding

Not only did the board have in mind the objective of bringing water service as near as possible to the ultimate consumer with the consequent better financing of the major cost of these necessary extensions through district credit, but by the foregoing procedure the board through its engineer will obtain eventually the general oversight and supervision of the subdivision plans of every tract in the district. The importance and necessity of "planning supervision," for which the law makes no provision, is apparent to anyone having had to do with the orderly development of as extensive a territory (17,600 acres) as embraced in the Vista Irrigation District, where very complex factors enter into the laying out of subdivisions suitable for proper irrigation, cultivation, avoidance of erosion, etc. Next to the direct financial benefit afforded the developer, this supervisory feature is of secondary importance only.

As practically no development had been possible prior to the completion of the system, and in view of the fact that the district was obligated to take any pay for a definite quota of water during the current and succeeding years, as detailed in a former article, the graduated scale of cash allotments was de-

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The EDITORIAL

MODERN Irrigation

Reg. U. S. Pat. Off.
Published Once a Month
AT LOS ANGELES, CALIFORNIA, BY THE
PETROLEUM WORLD PUBLISHING CO. *Editorial and Executive Offices, 626 South Spring Street, Telephone Broadway 3262.* Branches: CHICAGO—1163 MONADNOCK BLDG., *Telephone Wabash 8855;* JOSEPH E. O'CONNOR, *Manager.* NEW YORK—56 W. 45TH STREET, ROOM 1105, *Telephone Vanderbilt 3672;* WERNER HAUPTLI, *Manager.* SAN FRANCISCO—409 NEW CALL BLDG., *Telephone Sutter 5021-5020;* M. W. SCANLON, *Manager.*

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By Annual Subscription in the United States and possessions, $2.00; Foreign, $2.50; Single copies on sale in the irrigation country, 20 cents. In ordering change of address, give both the old and the new address. Allow ten days for re-entries on the subscription list. Advertising rates and circulation data upon request. Checks should be made payable to Petroleum World Publishing Co.

Vol. II DECEMBER, 1926 No. 12

A Business Proposition

IT IS conceded that the irrigation district provides, generally, the best and most feasible vehicle yet evolved for the financing, development and management of co-operatively owned irrigation enterprises Although viewed with little approval by the government reclamation officials in the earlier stages of the government's irrigation ventures, time has demonstrated the utility of this agency and the irrigation district has become the ultimate legatee of a government project.

The irrigation district is the logical expression of American democratic ideals and vests in a community in concrete form, the ownership and management of its basic utility. That the California statutes governing the organization and conduct of these organizations are faulty to an exasperating degree, and that some reform or reenactment can not much longer be postponed is very patent.

Irrigation districts are termed "quasi-municipalities" and in certain respects they conform to the municipal pattern. But the financing, construction and management of an irrigation enterprise involves successful combining of raw materials—land, usually in a raw or 'rare' state, and water—into a product to be utilized by a purchaser or purchasers for profit. That resembles a business enterprise more closely than municipal administration.

Boards of directors face, therefore very real business problems demanding business judgment, business foresight, and business initiative and courage. The present irrigation district statutes give very little direct, unequivocal encouragement or sanction for the exercise of such qualities, but still the inherent problems must be faced and solved successfully or disaster follows. The statutes enjoin on a board of directors the duty to so administer and conduct the affairs of a district as to accomplish the purpose and intent of the act; i. e., furnish water successfully and satisfactorily to the lands within a district. The injunction is plain and mandatory.

Faced with this responsibility, the directors of the Vista Irrigation District, through the counsel of their legal advisor, adopted a "rule of reason" policy and applied to their problems the same business methods and decisions that would be employed in a private enterprise of like character, except, of course, where directly prohibited by statute. In an article appearing in a former issue of MODERN IRRIGATION, and in one in this issue, are set forth solutions of practical managerial problems adopted by one of the newest but seemingly most progressive districts in the state. The direct results of these policies apparently have justified the business thought and initiative expended.

Corrosion's Toll

THE toll exacted by electrolytic corrosion, or electrolysis, from many industrial enterprises in our larger American cities runs into a fabulous sum yearly. It is almost impossible to estimate this loss in figures, but millions of dollars would be conservative. This economic waste which could be eliminated by the proper methods of correction, will undoubtedly be a subject for extensive treatment during the years to come. When one realizes the extent of the damage inflicted by these small stray currents, the need for corrective action becomes easily apparent.

It has been, and still is, common practice for street railway and traction companies to use the ground as a return conduit to the generating plant or sub-station. Of course, electricity will follow the line of least resistance to its objective, and if the return provided offers higher resistance than some other course, the latter one is naturally followed. As a general rule, this latter course is along some metallic pipe line or conduit used by the municipality or one of the other public utility companies operating in that vicinity.

Some of our more progressive cities, as for example, Washington in the District of Columbia, have already established corrective measures by proper legislation. Street railway companies or traction companies are granted their franchises upon condition that they take the proper precautionary measures stipulated by the government for

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POINT *Of* VIEW

the prevention of electrolysis. In this particular instance, they are required to use an independent line to the generating plant; that is, instead of a single trolley wire, a double line is used, thereby providing a conduit which does not come into contact with the ground. The generators at the sub-stations are not grounded, but connected to this independent return, and in this manner the currents are confined to a single path, which eliminates at the source any stray currents that might otherwise be generated. All electric motors operated within the limits of the district are provided with independent lines, and in no case is the ground used as a return. This applies to all industrial motors, such as elevator motors, factory motors, etc.

Undoubtedly it would be a costly procedure to make the proper corrections in most of our American cities at this particular stage of civic development, but the time is coming when such action will be absolutely necessary, and it would be well for the engineering fraternity to lay their future plans accordingly.

Solving a Sewage Problem

THE sanitary disposal of the trade wastes from many industrial plants is one of the biggest problems of the sanitary engineer. The advent of the activated sludge process and its application to trade waste problems, has opened up a new field for investigation. It is found that some of the wastes can be successfully treated by this method if mixed with domestic sewage, but not if treated separately without excessive costs for chemical precipitation. This is a problem which varies with individual plants and must be solved by local study of each particular trade waste.

There is no doubt but that the trade waste problems of many cities could be solved by properly designed activated sludge plants and that further studies will perfect methods for treatment of wastes not at present successfully treated.

The comparatively high cost of activated sludge plants has been one of the main objections to their adoption. The mechanical types show a power economy and require less labor attendance. So far data on the depreciation charges for this type are too meager to warrant any definite conclusions. It would seem that some form of mechanical aeration eventually will be found that will be the most economical form of activated sludge plant, especially for small installations.

The initial cost of an activated sludge plant is no greater than that of other methods giving as high grade of effluent.

The higher operating cost of activated sludge plants over other methods is due to more mechanical devices, higher power costs, and a greater labor overhead. The cost per million gallons, including depreciation, interest, labor, power, etc., has been found to run from $20 to $50 in the few plants where data are available. The initial cost of the plants varies from $10 to $30 per capita.

The wide variation in these cost figures serves to emphasize the fact that each municipality has a separate sewage disposal problem of its own and that cost data of other cities may not be at all applicable. Thorough preliminary investigation is necessarily to economically design a sewage disposal system, whether it be an activated sludge plant, or one of the other types. High operating, repair and alteration costs of many plants are directly due to a lack of preliminary investigations.

The New Pump Contract

ELIMINATION of waste in industry through standardization of methods and machinery, is a goal toward which marked progress has been made in the years since the war. This progress has been manifest in the automobile business, in the oil business, and other businesses where economic laws make success dependent on reducing waste to a minimum.

In the field of irrigation and waterworks in California the effort made during the last three years to standardize on a purchase agreement for deep well pumps is a notable development in this movement to eliminate waste. The recent completion and approval of such an agreement by the Western Irrigation Equipment Association and the Pacific Hydraulic Engineering Association, marks a milestone in standardization development. It is an agreement that attains an objective none too easy of accomplishment; it is a fair proposition both to seller and purchaser.

Before this purchase agreement can become standard practice, however, its approval by the California Farm Bureau Federation, as well as the University of California Agricultural College and the California Bankers Association, is essential. These bodies are studying the standard contract form and the hope has been expressed that within another year, the agreement will have met with the approval of all the agencies necessary to its general adoption.

Credit for the initiation of the plan to standardize on a purchase agreement for deep well pumps and the bringing of that plan to its present stage of realization must go to the Western Irrigation Equipment Association, certain members of which have given unreservedly of their time in the last three years in order that the idea might become an accomplished fact. We feel that the general approval of the agreement is merely a matter of time. The fairness and practical value of the agreement cannot be denied.

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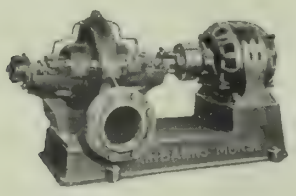

How much attention should pumping equipment require?

Take the Fairbanks-Morse pumping unit illustrated above. This motor pump outfit requires about the minimum attendance imaginable. Lubrication, for example, is a simple matter of greasing the bearings at six month intervals. Practically no other attention is needed. Every bearing is a ball bearing, which means that friction and wear are practically eliminated. The shaft is carried on permanently true centers and the proper running clearance is maintained between impeller and wearing rings.

This unit is typical of other Fairbanks-Morse pumping equipment that is setting new standards of dependable, economical operation and long life in irrigation service. One advantage of using Fairbanks-Morse equipment that has appealed to many irrigators, is the fact that a complete Fairbanks-Morse installation can often be used—all pumping and power equipment furnished by one manufacturer with no split in the responsibility for satisfactory service.

Whatever your requirements, investigate Fairbanks-Morse equipment for filling them. The advice of our engineers is always available. Write the nearest branch for bulletins and other literature.

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Coolidge Dam Interesting Innovation

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amounts to a maximum of 140 pounds per square inch. For this reason, while no steel is required when the reservoir is full steel is added, to take care of the temperature deformations and to tie the structure together. Steel reinforcement is also used in that portion of the dome forming the bridge and in the shoulder of the dome to provide for the shear induced by the bridge and the unsupported section of the dome. Although no steel is required in the buttresses, some is used to overcome the possible effect of shrinkage in the line of action of least stress. The sliding factor of the dam when the reservoir is full is 0.73 without uplift; with 50 per cent uplift at the heel diminishing to zero at the toe of the buttresses, it is 0.76. The overturning factor with the reservoir full without uplift is 2.83, with uplift 2.00.

In the design, as precaution against uplift, the foundation will be grouted; the dam will be anchored to its base and provided with inspection and drainage galleries. The stability factors conform closely to the usual custom and could be increased if considered desirable by giving the dam a flatter slope, but it is believed at a sacrifice of economy.

Estimate of Quantities

It is proposed to use a 1:2:4:2 concrete in the arches, 1: 2½: 5: 2½ mix in the buttresses which before the dam receives its full load should develop strengths of at least three thousand and two thousand five hundred pounds per square inch respectively, corresponding roughly to a factor of safety of five against crushing.

Owing to the massiveness of the dome type, the cost of the forms per cubic yard is comparatively low.

The estimated quantities of materials required for the construction of the dam are as follows:

Excavation: Sand, gravel (cu. yds.)..		26,000
Excavation: Dry, dam base and spillways above elecation 2316 (cu. yds.)	195,000	
Excavation: Wet rock, dam base below elevation 2316 (cu. yds.)	14,000	
Total Rock Excavation (cu. yds.)		209,000
Concrete (buttresses) (cu. yds.)	83,000	
Concrete (domes) (cu. yds.)	73,100	
Concrete (spillway floor, walls, and gate settings) (cu. yds.)	13,500	
Concrete (bridges over dam, on road to powerhouse, to outlet towers) (cu. yds.)	10,330	
Concrete (outlet towers) (cu. yds.)	2,300	
Concrete (power house base and house) (cu. yds.)	7,200	
Concrete (gunite and grout) (cu. yds.)	1,500	
Total concrete (cu. yds.)		190,930
Cement (bbls.)		223,300
Steel (reinforcing) (tons)		2,250

Exclusive of bridges and other items not common to the several types, the percentage of cost and quantities of concrete which the multiple dome dam bears to the other types of dam investigated are as follows:

Type of Dam	Per cent of Cost	Per cent of Quantity
Rock fill	74	...
Variable radius	89	62
Arch gravity without uplift	83	52
Arch gravity with 50% uplift	71	43
Multiple Arch	98	150

As a specific example it may be mentioned that the total concrete in the multiple dome dam is 156,100 cu. yds. as compared to 367,000 cu. yds. in the curved gravity dam figured with similar uplift.

While the estimated cost of the Multiple Arch type was in excess of the dome, the difference was too slight to be of any great importance. The two had also approximately the same stability factors and working stresses. The important difference lay in the fact that there was considerably more concrete in the Dome than in the Multiple Arch type, which rendered it more massive, with a probability of greater stability and permanence. The Dome type had such further security as the domes might afford and also possessed the advantage of being readily adapted to the development of electric power.

During the preparation of plans and estimates for the Coolidge Dam the designers had the assistance of a board of consulting engineers consisting of L. C. Hill and F. A. Noetzli of Los Angeles, California, and the firm of Wright and Gentry, architects of Los Angeles and Long Beach, were secured to design the architectural treatment. A second board of consulting engineers, consisting of General L. C. Langfitt of New York and A. J. Wiley of Boise, Idaho, was appointed to pass on the plans when they were complete. After a careful investigation this board recommended the construction of the multiple dome dam at the Coolidge site, and the plans were finally approved by the Secretary of the Interior May 8, 1926. Since the multiple dome dam is a new type the designers thus were fortunate in having two boards of eminent consulting engineers to pass on their work, all of whom belong to the American Society of Civil Engineers and are too well known to require special comment.

The Pacoima Dam, Los Angeles County, California, now in process of construction, proved its value during recent rains, according to a statement by G. H. Wray, engineer in charge. The impounded waters at the base of the dam measured 60 feet in depth and ran back a distance of 800 feet.

"Western Waterworks" Begins on Page 25

Standard Purchasing Form for Deep Well Pumps Gets O.K.

Progressive plans were made at the last meeting of the Western Irrigation Equipment Association, held the 19th of November, at San Jose, Calif., for the promotion of a new group of buildings for the California state fair grounds at Sacramento, to house the exhibits of the farm machinery and equipment manufacturers. Heretofore, such exhibits have been placed in tents rented by the state, and were very unsatisfactory from many standpoints.

E. F. SEWELL

Who has succeeded C. A. Utley, resigned, as secretary of the Western Irrigation Equipment Association. Mr. Sewell is associated with the Martin Iron Works, Los Angeles.

The association reported a very successful year. Probably the oustanding accomplishment of the twelve months was the completion of a standard form to be used in the purchase of deep well pumps. This form has been approved by the Pacific Hydraulic Engineering Association and Western Irrigation Equipment Association. It is a milestone in the merchandising history of farm equipment, and is fair to both seller and purchaser. A copy of this agreement may be obtained by writing the secretary of the association, E. F. Sewell, Martin Iron Works, Los Angeles.

The evening session of the meeting was started with a banquet, the toastmaster being Frazier O. Reed, of San Jose. At the close of the banquet papers were presented by Max Watson, Prof. R. L. Adams, and Fred C. Scobey.

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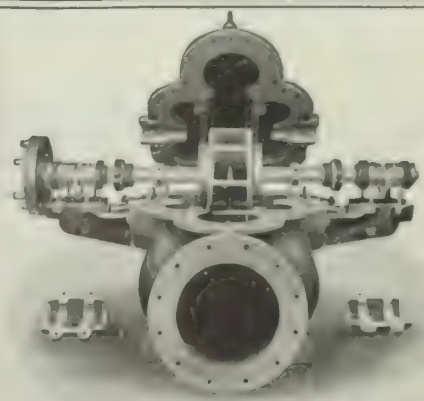

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Member Western Irrigation Equipment Assn.

"Western Waterworks" Begins on Page 25

Melones Dam Completion Significant Event

(*Continued from Page 16*)

feet stored at Relief, both reservoirs owned by the power companies. Since the signing of the contract the Sierra & San Francisco Power Company and the Pacific Gas & Electric Company have announced plans for a 53,000 acre feet reservoir to be built at Big Dam, above Strawberry, and a 7,000 acre feet reservoir to be built at Herring Creek. This will give the districts a total storage of practically 200,000 acre feet, sufficient for all future development.

The contract provides for the payment of the total sum of $5,175,000 in forty years, in semi-annual amounts of $64,687.50, each district to receive one-half. The first payment under the contract was expected to be made December 15 and semi-annually thereafter until the entire amount has been paid.

Still another clause makes the signing of the agreement mark the end of the dispute as to water rights on the Stanislaus river. All rights are declared settled, and the adjudication of the California Department of Public Works is accepted as final.

Following the election the districts immediately offered the bonds for sale, and placed the entire issue practically at par. The acceptance of the 5 per cent bonds at such terms was doubtless due in large measure to the double security of the assets of the two irrigation districts, and the contract by which the Pacific Gas & Electric Company agreed to pay the interest and principal. Since their original sale, they are now being sold on a 4.75 basis, showing the soundness of the co-operative agreement from a strictly financial standpoint.

Construction Began in July

On July 14, 1925, the contract for the construction of the dam, railroad and wagon-road was awarded to the Mathews Construction Company of Sacramento, at a round figure of $1,431,000. The total did not include certain materials which the districts agreed to furnish, nor the rights-of-way, which will bring the grand total to $2,200,000, the estimate of the engineers.

Work was started a month later, the contract calling for completion of the dam by March 15, 1926. Delays arising in difficulties in controlling the Stanislaus River prevented the completion of the dam in time for this year's irrigation, but two months ago the districts stored their first water behind the mass of concrete.

No fears are entertained but that there will be plenty of water available to fill the dam this winter.

The districts have water rights on the Stanislaus river consisting of 1046 second feet natural flow of the river, plus 770.6 second feet storage rights, making a total of 1816.6 second feet. Statistics show that the average annual run-off of the Stanislaus river is 1,300,000 acre feet, and that the water requirements of the two districts, when fully developed, are 560,000 acre feet, one-half the normal run-off.

The dam is 210 feet above bed rock. It is of the constant-radius arch type, the designs and plans having been prepared by A. J. Wiley, consulting engineer, of Boise, Idaho, who is one of the most eminent dam builders in the United States. Mr. Wiley designed the Don Pedro and Exchequer Dams, both recent construction projects in the San Joaquin Valley.

The length of the dam on the crest is 585 feet. The thickness at the base is 107 feet. Thickness at crest is 24 feet—radius 228 feet. Mass concrete in the dam amounts to 90,000 cubic yards —80,000 barrels of cement were used in the concrete. The foundation excavation was 32,400 cubic yards.

The outlet from the reservoir is controlled by six 2½ feet by 8 feet gates in the outlet tower, discharging into a concrete lined pressure tunnel through which both irrigation and power demands are supplied.

The tunnel is eighteen feet in diameter for a distance of 415 feet below the headgates, where four 60-inch (Johnson type) needle valves, with a capacity of 2,000 second feet, tap the tunnel for irrigation use. The power company is now constructing a 12-foot tunnel with a capacity of 1500 second feet, 4,000 feet in length, from the end of the districts' tunnel to their power plant, located down stream from the dam at the end of Iron Canyon Gorge.

Construction Details

The spillway for by-passing the flood waters provided over the rest of the dam consists of nine drum type spillway gates, each 12 feet in height by 57 feet in length. The combined weight of metal in the drum gates is over 600,000 pounds. They are the largest gates of this type ever constructed. The spillway capacity is double the maximum recorded flood of 20,000 second feet. Melones is the highest over-pour dam in the world.

The back water in the reservoir extends up stream from the dam site for a distance of twelve miles, submerging approximately 2,000 acres of land and creating 112,500 acre feet of storage.

To build the dam it was necessary for the districts to build a railroad 8½ miles in length, extending from Jack Siding on the Sierra Railway to the dam site. This required excavation of 97,000 cubic yards, mostly rock. The districts own and operate the last 2½ miles of railroad, using a Shay locomotive becaues of the sharp turns. The gravel for the dam was hauled from the Atlas Rock Company plant near Oakdale, the districts purchasing eight 80,000-pound gravel cars for this purpose.

It also required construction of a wagon road, 3½ miles long, to haul the materials for preliminary work into the dam site. The estimated cost of the dam, including the railroad and wagon road, was $1,657,000, which did not include the rights-of-way.

The construction of the dam was the work of the Mathews Construction Company of Sacramento, and the construction program has been carried on under supervision of George K. Parker, as superintendent, and H. L. Leventon, assistant superintendent.

In addition to A. J. Wiley of Boise, Idaho, who designed the dam and has been the consulting engineer, the technical staff includes R. E. Hartley of Oakdale, chief engineer; C. L. Riley of Manteca, associate engineer; George D. Macomber of Oakdale, resident engineer, and Vern L. Peugh, assistant engineer.

Gillespie Dam Is Sold

The Gillespie Irrigation project, lying about 60 miles southwest of Phoenix, has been sold to an Eastern syndicate for about $5,000,000, according to announcement recently made. The purchase includes over 80,000 acres of land north and west of Gila Bend, a forty-mile canal and a multiple arch diversion dam across the Gila river. The project is one dating back to the early '90's, promoted by Lewis Wolfley, then territorial governor of Arizona. At the time of sale title was held by the Gila Water Company, in which the president and principal stockholder is F. A. Gillespie, of Los Angeles.

Credit to A. W. W. A.

In three instances in its last issue Modern Irrigation failed to give credit to the California Section American Water Works Association for papers printed in that issue and previously read before the annual meeting of the California Section at San Diego. Mention should have been made of the fact that the articles by William Mulholland, J. H. Fagg and Dr. Carl Wilson were originally read as papers before the waterworks convention and reproduced in Modern Irrigation through the courtesy of the editor of the Journal of the American Water Works Association.

"Western Waterworks" Begins on Page 25

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"Western Waterworks" Begins on Page 25

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CONCRETE PIPE
FOR WATER LINES

Following is the Report of Internal Pressure Tests Made by G. T. McIntyre, Inspector for Laguna Beach (California) Water District; J. B. Lippincott Co., Engineers:

Dia.	Nos.	Wall Thick-ness	Cem.	Mixture Sand	Rock	Age days	Working Pressure in Line	Tested To	Seepage
27"	20	2 5/8"	1.0	2.3	½	14	55 lbs.	110 lbs.	none
27"	26	2 5/8"	1.0	1.0	1.0	14	55 lbs.	110 lbs.	none
27"	3	2 5/8"	1.0	2.3	none	16	55 lbs.	110 lbs.	none
27"	17	2 5/8"	1.0	2.3	none	15	55 lbs.	110 lbs.	none
27"	37	2 5/8"	1.0	1.0	1.0	15	55 lbs.	105 lbs.	none
27"	1	2 5/8"	1.0	2.3	1.4	17	22 lbs.	85 lbs.	none

Note: None of specimens failed at above pressures. All pipe were tested 10 minutes at 10 pounds and 20 minutes at the high pressures without seepage. All pipe were selected at random by the engineer and tests are shown on all pipe so selected.

Facts That Speak for Themselves

This pipe is impervious to soil corrosion and free from leakage at high pressures. Tests show unit tensile strength in excess of 500 pounds per square inch, which is double that of the best concrete by old methods.

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"Western Waterworks" Begins on Page 25

WESTERN
Waterworks
Supplement to Modern Irrigation
Of Interest Expressly to Waterworks Executives, Contractors, and Municipal Engineers

Problems of a Sub-Surface Water Supply

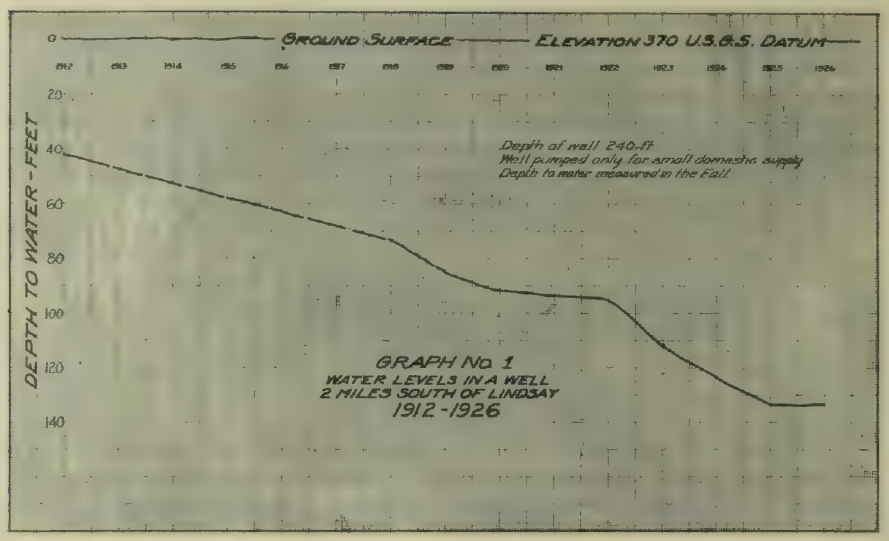
With Particular Reference to the Lindsay Strathmore Irrigation District, California

By GEORGE W. TRAUGER
Superintendent, Lindsay Strathmore Irrigation District

THE Lindsay Strathmore Irrigation District was organized on November 9, 1915, under the "Irrigation District Act of the State of California." It extends from the Southern Pacific Railroad on the west, eastward to the westerly slope of the Sierra Nevada Mountains, and from a point three miles north of the town of Lindsay, southward to Strathmore. Its boundaries are irregular. Its gross area is slightly over 15,000 acres. The district lies wholly within Tulare County. Prior to the year 1900 the land now within the district was used either for dry farming or allowed to be fallow. By 1903, five hundred acres of the area had been planted to orange trees, many of which were in bearing. These plantings showed that valuable citrus crops could be produced by irrigation with water pumped from underground sources. As a consequence, the development from 1903 to about 1914 or 1915 was rapid, and by the end of 1914, over 7,000 acres had been planted to citrus crops. Of these about 6,000 acres were in full bearing. Practically all of the San Joaquin Valley is semi-arid, in the sense that irrigation is necessary to the profitable production and this is particularly true of that portion of the valley now known as the Lindsay District. The increased draft on the water sources to serve this additional planting, so lowered the water table that the supply showed evidences of depletion as early as 1912 or 1913, and by 1915 the water supply had given out entirely in some areas, and in others it had become so salty that its use for irrigation purposes became injurious, if not absolutely destructive of the crops and trees to which it was applied.

It therefore became necessary for the land owners to acquire other water sources from which a sufficient supply could be obtained. Otherwise the area about Lindsay would revert to desert conditions of earlier days. About ten miles north of the town of Lindsay there was found a tract of land lying on both sides of the Kaweah River, known as the Rancho de Kaweah, and consisting of coarse sand and gravel filled to the surface with water. Opinions of competent engineers were obtained to the effect that sufficient water to supply the needs of the citrus groves

Wheel for the removal of algae—Lindsay Strathmore Irrigation District, California


GROUND SURFACE
ELEVATION 370 U.S.G.S. DATUM
DEPTH TO WATER - FEET
Depth of well 240-ft
Well pumped only for small domestic supply
Depth to water measured in the Fall
GRAPH No. 1
WATER LEVELS IN A WELL
2 MILES SOUTH OF LINDSAY
1912-1926

in and about Lindsay could be obtained by pumping from this underground basin, and relying thereon, the Lindsay Strathmore Irrigation District was organized in 1915; the Rancho de Kaweah was purchased, and thereafter thirty-nine wells, spaced at one-eighth of a mile apart, were bored, and are now and have been since the year 1918, pumped and the water obtained thereby transported to the lands within the Lindsay District.

About 12,000 acres of citrus orchards to the west of the Southern Pacific Railroad remained out of the district, feeling that their supply was ample and would hold out with the discontinuance of pumping on the east. About 500 acres located inside the district boundaries also decided to take a chance on their wells in preference to coming in. Practically all of these last mentioned lands exhausted their supply in a few years and have since been taken into the district.

This was done by buying unimproved lands within the district and thereafter excluding them and substituting the improved lands in their place. This entire project was approved by the State Engineer, and by several very well known engineering firms; bonds of the district were approved by the State Bond Commission, and were sold at or very near par. The outstanding bonds consist of two issues: the first issue in the amount of $1,400,000.00 sold at a premium; and the second issue of $250,000.00 sold at slightly below par.

Local History

The history of our water conditions is similar to that of many other parts of California. The area west of the Southern Pacific Railroad, before mentioned, is now finding that it also has a water problem. Its supply is greatly depleted; many wells have become salty; the water table has been lowered beyond an economic lift. This is due to several causes: First, many sections have developed by the use of underground waters, without any study of the amount available, and the possibility of replenishment. It should be the purpose of men who develop projects of this character to prevent over-drafts on underground basins. This is done by our State where districts are formed, but I have in mind cases where an individual will drill a well, get water and profitably raise crops; then another comes in, does likewise.

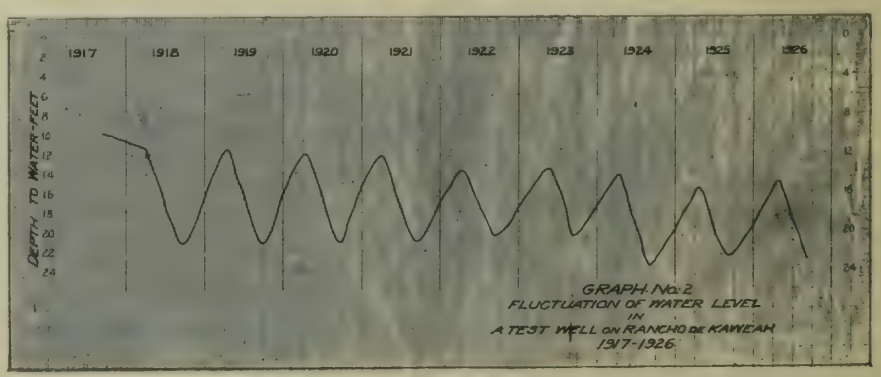
Some real estate company buys large tracts, sub-divides the same and sells to innocent purchasers on the strength of what this or these men have done. In the course of a few years there is not an adequate supply, and failure for many is the result. I favor either a state or even a county control of drilling wells. This may be impossible. There certainly should, however, be some control of men drilling wells, to protect the public. Enough money has no doubt been wasted by poor well drilling, poor equipment and unscientific methods, to build many good storage reservoirs. Many of these men don't even know how to keep a log of a well. I have known many cases where a rancher has drilled a well usually for convenience near his property line, sufficient for his needs; then his neighbor drills just across the line; then they play hide-and-seek with each other until one "goes broke." I know whereof I speak. I have lived on an orange grove, and still do, and have seen this very thing happen many times. The state keeps tab on the drilling of oil wells; why not on water wells?

Second: There must be a greater effort made to conserve our water in times of heavy run-off, both by building reservoirs, and when these are full by spreading as much as possible to build up the underground storage. This means a study of the underground basins, and means of replenishment. The great advantage of underground storage is not fully appreciated: In our own case, the past three years have amply demonstrated that where it is possible this is the best possible storage. We were able to meet our needs in a fairly satisfactory manner, when almost any other plan would have left us "high and dry." In many cases the underground storage basin is filled by fall and winter flows that otherwise would be lost, leaving available for spring and early summer irrigation a greater amount of water. For this reason a better study should be made and a systematic way worked out for the filling of these basins.

History of Kaweah River

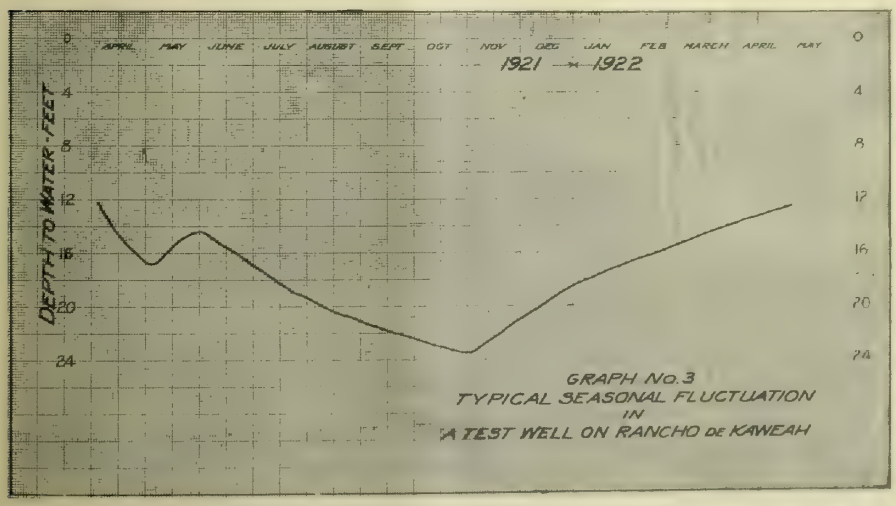
A condition that is true of the Kaweah River is also true of many other streams of California. This river, with a watershed of about 600 square miles, rises at the top of the westerly slope of the Sierra Nevada Mountains at an elevation of 10,000 to 12,000 feet. This stream with its tributaries has an annual run-off of about 450,000 acre feet. from 1915-16 to 1925-26 the average run-off was 295,000 acre feet. From 1906-07 to 1915-16 it was 458,700. This is 1,550,000 acre feet less than normal for the past ten years. These figures, which do not take into account the big year of 1905-06, account in a large measure for the present acute condition.

Curve No. 1 shows the fluctuations of a well southwest of Lindsay in a section that locally is considered good. The well, 240 feet deep and used only for a small domestic supply at the house,



is a good example. Measurements cover a period of 14 years. The ground surface is at an elevation of 370 feet. In 1912, the water in this well stood at 42 feet from surface. By 1918 it was 73.2 feet. By 1923 it was 111.7 feet, and in September, 1926, it was 133.2 feet from the surface. All other measurements were made in October. The graph shows intervening years.

Curve No. 2 shows the fluctuations of water in an index on the Rancho de Kaweah, and which is about a mile distant from the river. It is used for keeping track of the elevation of the ground waters. The purpose of this graph is to show how an underground reservoir will store and hold water, especially where there are often early fall rains which bring up the flow of the rivers, and heavy floods during the winter and spring. The fall and winter flows will replenish the basin, in most cases, before the water is needed in the regular irrigation period. This well is at an elevation of 411 feet, about ten feet higher than flood level of the river, and never according to our records subject to overflow. It is in an area where about 14,000 acre feet has been pumped out each year for the past eight years. It gives a good idea of how water can be stored, used and replenished. On April 3, 1918, before any pumping had been done in this area there being no wells closer



GRAPH NO. 3
TYPICAL SEASONAL FLUCTUATION
IN
A TEST WELL ON RANCHO DE KAWEAH

than two miles or more, the water in this well was 11.5 feet from the surface. On April 29, 1926, the water was only 14.9 feet from the surface. It must be remembered that in this section of the San Joaquin Valley, the years 1924, '25, and '26 were very dry, but with all this pumping and dry years, we only have a loss in ground water elevation of 3.4 feet. The graph shows the intervening years.

Too Much Water a Detriment

Curve No. 3 on the same well shows the draw-down over a period of a year, measurements being taken each month, and the year 1921 used—a normal year in rainfall, snowfall and run-off. On April 4, 1921, the depth to ground water was 12.3; by May 2, 1921, it was 16.8 feet; on June 1 it had come back to 14.4 feet, due to flood waters from melting snow, river over-flowing its banks. By November 2 it had reached its lowest point, 23.5 feet, and by April 7, 1922, it was back to 13.7 feet, and on May 4, 1922, it was 12.6 feet, or only .3 of a foot lower than the previous year. Many of these areas that are pumped have been greatly benefited by holding the ground waters below the root area of the growing crops and in many districts pumping is absolutely necessary to keep the ground from becoming water-logged.

At this point I wish to tell of the owners of 60 acres of orange orchard, who came in one day to find out if we would install a meter for them. They were part owners in a large well, the water was not measured and they felt they were not getting sufficient for their needs, or in fact their share of the water. I found out before getting through with them, that at the time they were planning to buy drainage pipe to draw off water, and that even the water they were getting was just twice what they needed for an orange grove, located as theirs was on very heavy soil. I had to show them some mighty fine groves, with a metered system, using the needed amount, to convince them. This only goes to prove, as I believe, that in very many cases ground waters are being used far beyond reasonable requirements, and in many cases to the actual injury of crops.

History of Litigation

A short review of the history of the litigation in which the Lindsay Strathmore Irrigation District is involved may be of interest. Furthermore, the effect of its final outcome upon our district may be of vital importance to other districts and municipalities. The original complaint was filed on the 15th day of July, 1916. Included among the plaintiffs were one irrigation district, 17 mutual water companies, and 56 individuals. The purpose of the action was to enjoin the Lindsay Strathmore Irrigation District from pumping water on

Continued on Page 16

Use of Water for Special Purposes Presents Big Field for Research

Data for Consumption in California Cities Is Presented to Stimulate Work Along This Line

By CHARLES H. LEE

Consulting Hydraulic Engineer, San Francisco

The Author's Conclusions

IN DOMESTIC service alone the depth seldom exceeds 2.1 feet per annum, including the irrigation of large beautified estates. For human needs alone the depth is less than 1 foot.

Industrial demand requires a maximum of possibly 5 or 6 feet depth per annum, although data is lacking for a definite determination.

In commercial districts the demand may run as high as 24 feet per annum.

The duty of water in irrigation varies from 1.25 to 4.58 feet per annum.

Graphical analysis of water consumption data on the basis of depth of water and density of population offers a method for comparative study which is simple and comprehensive.

"Service area acreage" should be added to the items listed in the Manual of Water Works Practice, as the least which a waterworks system should have (pp 433-4).

The making of special tests of the depth of water delivered in various types of waterworks service should be encouraged.

WATERWORKS reports are usually lacking in information regarding the use of water for special purposes, such as domestic, commercial or industrial. The rate of per capita consumption, as determined from statistics in such reports, is a composite made up of all varieties of use, and throws out little light upon any one type. The only available sources for such data are reports of special tests. With the increased tendency toward zoning, as stimulated both by city and regional planning programs, more detailed information is coming to be in greater demand. The following specific data for consumption in California cities have been obtained from various sources, and will be presented in the hope that it will stimulate the more systematic collection and publication of such information. In addition to other uses, such data would be very valuable in distribution system design.

Domestic use includes that necessary for human needs, such as drinking, cooking and washing. To this should be added the water used for irrigation of gardens and lawns, where such is necessitated by local climatic conditions. Table I indicates the amount of water delivered for this purpose, as indicated by various tests.

The influence of lawns and gardens in increasing the rate of domestic consumption is quite apparent. First-class residential areas, for example, with large improved estates consume three times the quantity of water used on areas where the demand is limited to strictly human needs. It is to be noted in using these data that, with the possible exception of the area served by the Belvedere Water Corporation, the data apply to fully built-up districts. The service area as reported for a whole city, on the other hand, would ordinarily include isolated vacant lots and other small non-consuming areas.

"Commercial Use" Defined

The term "commercial use" as generally applied, includes not only the strictly commercial use of water in hotels, stores, office buildings and apartment houses, but also industrial use by manufacturing plants, railroads, sugar refineries, laundries, etc. Commercial use is usually small relative to total consumption, and is constant in amount.

Industrial use, however, may be very large in amount and varies with business conditions and the relative cost of water from the public system and from privately developed sources. Considered from the standpoint of areas, the two services seldom overlap. With haphazard growth, commercial and industrial plants are seldom to be found mingled, and modern zoning practice tends to emphasize the separation. For purposes of

*Excerpt from a paper read before the annual meeting, California Section American Water Works Association

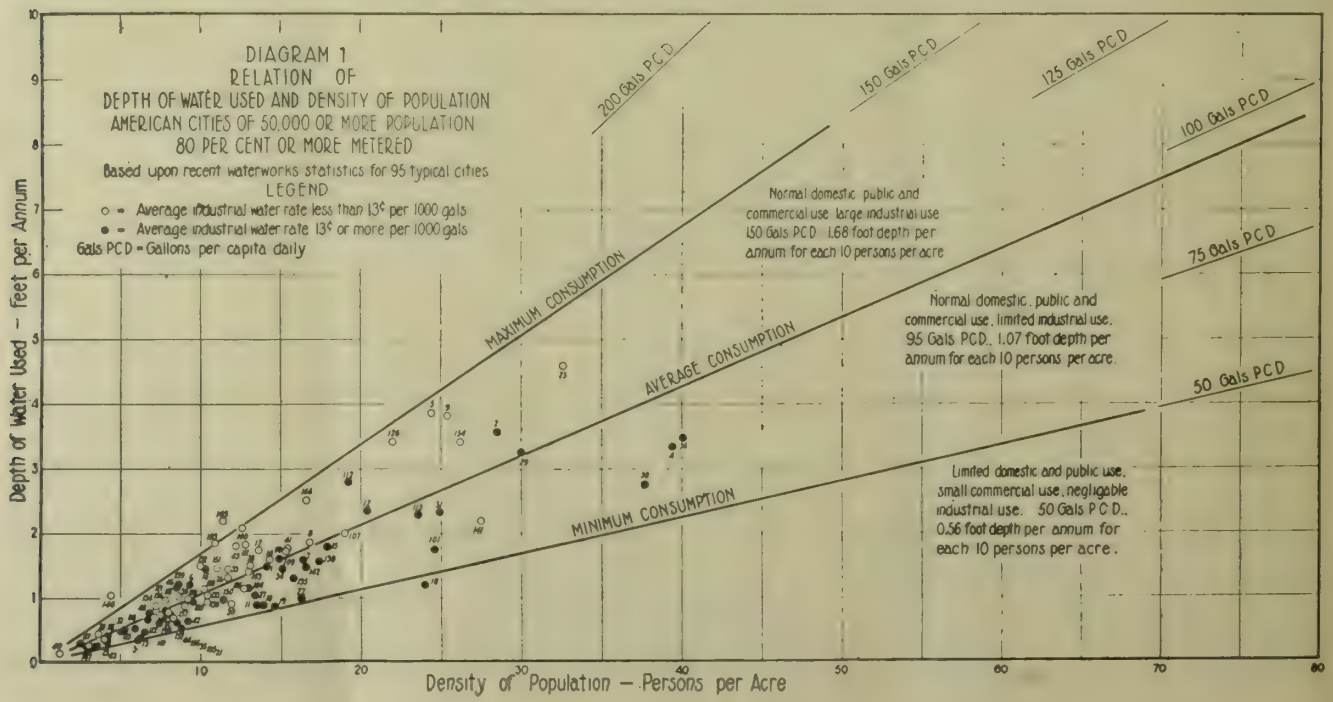


DIAGRAM 1
RELATION OF
DEPTH OF WATER USED AND DENSITY OF POPULATION
AMERICAN CITIES OF 50,000 OR MORE POPULATION
80 PER CENT OR MORE METERED
Based upon recent waterworks statistics for 95 typical cities
LEGEND
○ = Average industrial water rate less than 13¢ per 1000 gals
● = Average industrial water rate 13¢ or more per 1000 gals
Gals PCD = Gallons per capita daily
200 Gals P.C.D.
150 Gals P.C.D.
125 Gals P.C.D.
100 Gals P.C.D.
75 Gals P.C.D.
50 Gals P.C.D.
MAXIMUM CONSUMPTION
AVERAGE CONSUMPTION
MINIMUM CONSUMPTION
Normal domestic, public and commercial use, large industrial use 150 Gals P.C.D. 1.68 foot depth per annum for each 10 persons per acre
Normal domestic, public and commercial use, limited industrial use. 95 Gals P.C.D., 1.07 foot depth per annum for each 10 persons per acre.
Limited domestic and public use, small commercial use, negligable industrial use. 50 Gals P.C.D., 0.56 foot depth per annum for each 10 persons per acre.
Depth of Water Used – Feet per Annum
Density of Population – Persons per Acre
0
1
2
3
4
5
6
7
8
9
10
10
20
30
40
50
60
70
80

estimating future water requirements, it has been found very useful to have the two services considered separately, and they will be hereafter so considered in this paper.

The amount of water used in commercial service, although a small proportion of total consumption, is large when expressed as depth upon the area to which the water is actually delivered. This is illustrated by a test made by the Bureau of Waterworks and Supply of the City of Los Angeles for the consumption in the congested business district bounded as follows:

Hill St. from First to Fifth St., Fifth St. to Grand Ave., Grand Ave. to Sixth, Sixth St. to Figueroa, Figueroa St. to Ninth, Ninth St. to Los Angeles, Los Angeles St. to First, and First St. to Hill. The water delivered to this area of 324 acres in September, 1923, was equivalent to a depth of 2.16 feet. As the rate of delivery to this area is practically constant throughout the year, the annual depth may be considered as 24.36 feet. Spread over the whole city service area this amounts to but 0.10 feet in depth, as compared with the total annual depth for all purposes of 1.74 feet.

Good Field for Study

The amount delivered for industrial purposes in the typical area of 183 acres bounded by Seventh, Sacramento and Alameda streets, and Los Angeles River, was also measured. This area received during the period July 1, 1923 to June 30, 1924, a depth of 1.67 feet of water. This quantity is very small in comparison with the amount of water consumed in the industrial districts of many eastern manufacturing centers. For the larger American cities, the water used in industrial purposes, if spread over the whole city service area, exceeds 1.50 feet.

As industrial plants occupy a minor portion (less than one-fourth) of even the most distinctively industrial cities, it is to be inferred that the annual depth consumed on the area actually devoted to industrial use may be as great as 5 or 6 feet, and may even exceed this figure in the case of special industries using large quantities of water for washing processes. Data are very meagre on this subject, and, with the prospective industrial growth in many western cities, special effort to obtain such information for different types of industry would be well worth while.

Water for Irrigation

It frequently occurs in western cities that irrigated areas are included within the municipal boundaries. Such lands may either be temporarily used for commercial agriculture in the raising of berries, garden truck, or flowers, or may be more permanently devoted to residential or recreational purposes. Golf courses and public parks and playgrounds may be included within the latter. Often as a city expands it encroaches upon irrigated farm land devoted to the growing of orchards or general crops. The question thus arises in waterworks practice as to the quantity of water used by such land under irrigation, as compared with the needs of the same land under suburban or urban conditions. The subject of the use of water in irrigation is beyond the scope of this paper, but for comparative purposes certain general data may not be out of order.

TABLE I
DEPTH OF WATER IN DOMESTIC USE

Character of domestic use	City	Authority	Depth of water used in feet per annum
First class residential—large improved estates.	Los Angeles	Bureau of Water Works & Supply	2.14
First class residential—large improved estates.	Atherton	Charles H. Lee	2.10
First class residential—large lots with lawns and gardens	Los Angeles	Bureau of Water Works & Supply	1.90
Second class residential—small lots with lawns and gardens	Los Angeles	Bureau of Water Works & Supply	1.61
Third class residential—small lots, many with gardens	Los Angeles	Bureau of Water Works & Supply	1.35
Third class residential—small lots, few gardens	Belvedere, Laguna and San Antonio Twp. adjacent to N. E. Limits City of Los Angeles	Belvedere Water Corporation	0.68

Factors Governing Consumption

The amount of water required in irrigation depends upon many factors, among which may be mentioned climatic conditions, including temperature and precipitation, soils and crops. For lands already under irrigation the stage of economic development of the region and the character of the people are important factors. Recent comprehensive studies made by the State Engineer show that in California the amount of water actually used in various parts of the state for irrigation of general crops varies in depth from 1.14 feet to 3.88 feet per annum, and that a corresponding desirable duty would vary from 1.25 feet to 3.00 feet.* These figures are for water delivered to the land, and do not include the large losses in transmission often amounting to as much again as that delivered.

The following table compiled from the State Engineer's report gives the average measured use and desirable duty of water in the vicinity of the larger cities of California.

TABLE II
Average Measured Use and Duty of Water in Vicinity of Large Cities of California

City	Measured Use Depth in Feet	Desirable Use (Duty) Depth in Feet
San Diego	1.26	1.25
Los Angeles	1.62	1.75
Bakersfield	2.24	2.00
Fresno	2.24	2.00
Stockton	2.24	2.00
Sacramento	3.88	2.25
Santa Barbara	2.43	1.5
Santa Cruz	1.42	1.5
Monterey	1.82	1.75
San Jose	1.42	1.50
San Francisco	1.42	1.50
East Bay Cities	1.42	1.50
Eureka	1.52	1.25

It is to be recognized, however, that the above values represent broad averages and that considerable local variation from them is to be expected. Taking up more detailed data, the irrigation use for general crops in the San Fernando Valley within the boundary of the City of Los Angeles, as served from the city's irrigation system, is reported as follows by the Bureau of Waterworks and Supply:

TABLE III
USE OF WATER FOR IRRIGATION IN SAN FERNANDO VALLEY, CITY OF LOS ANGELES, CALIF.

Year	Recorded Gross Average Use	Net crop Average Use	Recorded Gross Duty Depth in Feet	Net Crop Duty Depth in Feet
1919	[illegible]		1.06	
1920	[illegible]		1.09	
1921	63,300	33,000	1.20	1.18
1922	[illegible]		1.30	
1923	[illegible]	52,810	1.43	1.60
1924	[illegible]	51,723	1.02	1.20
Average			1.18	1.39

More than half the acreage in the San Fernando is planted to crops requiring but little irrigation, such as beans, walnuts, etc. Where a considerable pro

(Continued on Page 57)

*Irrigation Requirements of Crops in California. Bulletin No. 6, State of California Department of Public Works. 1923.

STORAGE & DISTRIBUTION

Cooperation of Utilities Is Doing Much to Solve the Corrosion Problem

Better Rail Bonding, Use of Larger Rails and More Substations Have Reduced Loss from Electrolysis

By E. B. STEWART

Electrolysis Engineer, East Bay Water Company, Oakland, California

Editor's Note: This is the second and concluding installment of a paper on corrosion problems of a water supply system and methods of protection, read by Mr. Stewart before the recent annual convention of the California Section of the American Water Works Association at San Diego, Calif. The first part, printed in the November number, concerned soil corrosion, whereas part two discusses corrosion from externally applied electric currents and preventive measures.

CORROSION from stray current is of special importance in cities where buried metallic conductors come in more or less close association with electric railway systems. The chief factors involved in dealing with stray current electrolysis comprise the testing for, and the control of, stray currents responsible for the damage.

The majority of the street railways of the country are operated on the single trolley system using the rails to return the current back to the power station. The total current, however, will not return to the power station by the rails; a part of the current will shunt from the rails to earth in the negative area and find its way to nearby networks of metallic underground structures and flow on them in a general direction toward the substation. As the station is approached, the current tends to leave the structures to earth and return to the rails. Corrosion will take place where these currents leave the pipes to earth.

Another Source of Damage

Experience has shown that stray currents also leave the pipe in the negative zone at remote distances from the ends of the car lines, a condition which is somewhat contrary to the usual explanation of the flow of stray currents. This condition is made possible by two separate tracks leading from the same power house and laid out in such a way that the return of one line is almost without loss of potential, while the other has considerable loss. In this case part of the current will leak across through the earth to the track which is without loss of potential. These currents will accumulate on the pipes running in the same general direction and very often cause rapid corrosion.

An example of corrosion from stray current in accordance with these conditions was found at a point one mile distant from the end of the nearest railway line. Earth current measurements showed an average current of six milliamperes leaking to earth from every square foot of pipe. This is an unusually high leakage current, when it is considered that leakage values below .5 of a milliampere per square foot are considered safe.

Preventive Measures

The magnitude of stray currents is determined by the design, construction, maintenance and operation of the railway system. In the effort to eliminate the corrosion from stray railway current, the most logical procedure is to attack the trouble at its source, the production of the stray currents.

An analysis of the power distribution and the operation of the railway is the most essential factor to consider when making electrolysis surveys.

The question of electrolysis has been very actively studied for a number of years by the "American Committee on Electrolysis," which was formed from representatives of the various public utility associations whose interests were affected. Most members of this association are probably familiar with the report of the committee issued in 1921. This report represents the unanimous opinion of the representatives of all the different interests involved.

A matter of particular concern is the study and development of railway distribution. Considerable progress has been made in recent years in the development of automatic, semi-automatic and remote control substations, and these are now being used on both city and interurban lines. The economic operation of such substations makes possible a greater number of feeding points than can economically be supplied through manually operated stations. The increase in the number of substations will obviously reduce the feeding distances, and effect a saving in distribution copper, and a saving in line and return losses. The general effect is the reduction of track voltage drops; thereby reducing the leakage of stray current into the earth.

Important Development

This is a very important development in railway operation for the protection of damage to pipes from electrolysis, as the same factors that determine economy of railway operation also control the leakage of stray currents to earth.

Within the last year, four additional substations have been added to the local railway system within the territory affecting our piping system and recent surveys show that such measures have materially reduced stray currents in the piping systems.

The principal measures used by this company to eliminate or reduce corrosion from stray current are:

1. Electrical drainage.
2. Insulating joints.
3. Electrical connections between pipes in close association.

Electrical Drainage

Electrical drainage is used to drain enough current to make the pipes negative to the earth in the vicinity of negative feeder connections. While electrical drainage is not considered good practice by many engineers, nevertheless, under certain conditions, it appears to be the best temporary expedient consistent with economy. Where large mains are already in place, it seems logical to apply a limited amount of drainage until such time as remedial measures can be applied to the railway system. Electrical drainage is applied in cooperation with other utilities through committee activites which will be discussed later in this paper.

Where drainage systems are in use, very careful surveys and inspections must be made at frequent intervals if adequate protection is to be realized, as changes and extensions to either railway or underground systems will establish added points of hazard.

Care must be taken to avoid unequal drainage between pipes that are in close association. The drainage of one system of pipes will, of course, lower its potential with respect to the neighboring pipes tending to injure the latter. This in turn calls for drainage of the

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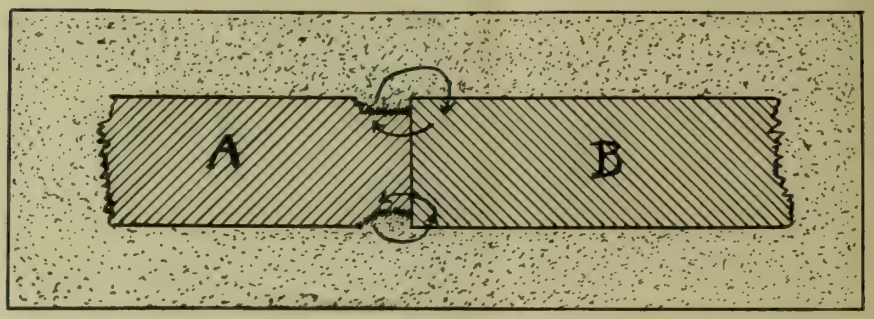

Diagram illustrating galvanic action between two dissimilar metals in contact buried in soils. A. Electropositive metal which is corroded. B. Electronegative metal which is protected against corrosion at the expense of the electropositive metal.

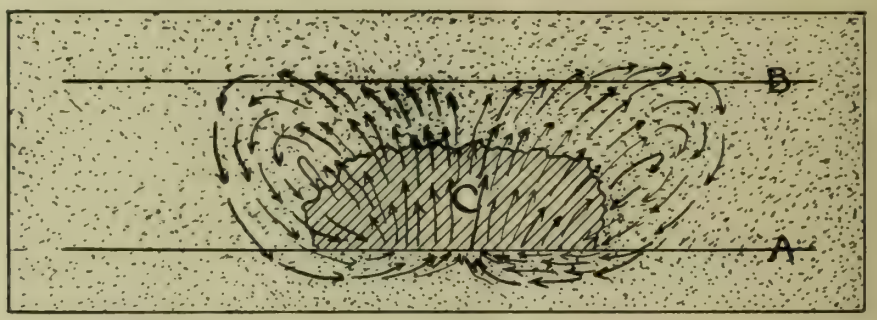

Diagram illustrating how corrosion is accelerated by two pipes in close association in the earth. Pipe "B" acts as a conducting medium to complete a galvanic circuit from the area "C" of high concentration.

injured system which may in turn damage the first or other structures and consequently a system of competitive drainage is established.

Overdrainage of cable systems is very often a hazard to pipe structures. Pipes as a rule are much closer to cable conduits in the ground than they are to rails. In many cases, the pipes are resting directly against the conduit. Under such conditions where both metals are in wet soil, it is possible for large leakage currents to flow and cause damage to the main or service pipe. In one particular instance, overdrainage of cable systems caused serious damage to one of our transmission mains on a street where no electric railway tracks exist. This condition brings out the fact that potential measurements between pipes and cables should not as a rule be confined to streets having railway tracks.

Insulating Joints

Insulating joints are used in new pipe lines and some existing lines in negative and neutral zones with particular reference to those points where it is expected that large transverse currents are flowing between parallel rails due to unusually high voltage drops between them, or where it is expected that currents will be transmitted to and discharged from the pipes in soils of low electrical resistance. In the insulated sections, the service pipes are prevented from making electrical contact with other piping systems by the use of insulating joints at the meters. Without insulating joints in the service pipe, stray current could enter from the other piping systems through gas water heaters and other appliances with which it comes in contact and injury would result to both the service and the section of the main to which it connects. It is often necessary to install insulating joints on cross mains which connect the insulated sections.

We have found from laboratory studies, together with studies in the field under working conditions, that cement used as an insulating medium offers the highest electrical resistance to the flow of stray current, and when joints are placed at regular intervals of approximately 100 feet, the current flow on the pipe lines is reduced to relatively small values. Resistance measurements of a number of insulating joints that were in service for approximately three years, showed an average electrical resistance of .6 ohms in soils having a resistance below 1000 ohms per cubic centimeter. In many cases the resistance of an insulating joint is greater than the resistance of 400,000 feet of pipe.

Objection Answered

The principal objection that has been raised to the use of insulating joints is that corrosion is apt to occur on the positive side of the joint. During the last four years we have engaged in regular tests and inspections for joint corrosion, and to date no corrosion from this cause has been located. The reason why such installations might fail to protect the

pipes in many instances is the too infrequent use of insulating joints especially if the pipe line is laid parallel with high potential gradients in the earth.

For example, in a case, where the difference of potential in the earth is, say, ten volts per 1000 feet, and a pipe line is located in a direction approximately parallel to the electromotive force, heavy currents will, as a rule, be picked up by the pipe, and if this is discharged into the earth, serious damage will, of course, result. If the continuity of the pipe is broken up by inserting insulating joints, then practically all of the potential drop would be concentrated at the joints. For instance, if two insulating joints are inserted in a pipe 1000 feet in length, the drop across each joint will be approximately five volts.

Since the leakage path around such joints is usually very short, it is evident that high voltage potentials will produce a correspondingly high current density across this short distance in soils of low electrical resistance, and as a consequence, sufficient currents will flow around the joints to destroy them within a comparatively short time. It is evident that in order to prevent this, a sufficient number of insulating joints must be used so as to reduce the current density around the joints to a practical minimum. In other words, the frequency with which insulating joints may be placed to secure adequate protection against electrolysis is determined by two factors, namely, potential gradients in the earth and electrical resistance of the soil.

To illustrate a practical example of the effectiveness of insulating joints, a sixteen-inch non-insulated steel pipe having been destroyed beyond repairs after less than three years' service, was renewed with the same size and kind of pipe with insulating joints placed at regular intervals of 100 feet. This pipe has been in service a little more than four years, and to date, it has not suffered damage from electrolysis, although subjected to the same stray current conditions.

Earth Current Meter

The most difficult part of an electrolysis survey, perhaps, consists in drawing proper conclusions. No one set of measurements will suffice as a basis. While potential measurements represent the tendency to produce stray currents, the currents which cause the damage are determined as well by the restivity of the soil, which varies over wide limits from one part of the city to another. Currents flowing in the pipes will be affected by the relative location of the pipes and the rails in the streets. Services or mains

(*Continued on Page 56*)

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METERS & METERING

Electrically Operated Flow Meters Show Trend Toward Efficiency

WITH the great advancement which has taken place in engineering practice, realization of the importance of making systematic and accurate measurements of the conditions and quantities involved has grown rapidly. At the same time, the desirability of locating the meters at points of greatest convenience to the users is more keenly appreciated today than ever before.

An example of this trend is supplied by the popularity of flow meters of the electically operated type by the use of which an indicator may be located in clear view of the boiler fireman as a guide in firing, with the recorder and integrator placed at a convenient point among a group of recording instruments.

No Mechanical Motion

Also, from another point of view, electrical operation is especially advantageous for flow meters, since it affords a means of producing external indications and records of conditions existing inside of a high pressure steam or water pipe, without transmission of mechanical motion—as for instance, by means of a rotating shaft, passing through a pressure-tight packing gland, which of course would be essential and would necessarily cause serious friction losses.

Naturally, however, when electrical means are introduced to avoid the objectionable features of a mechanically-operated instrument, other undesirable features are likely to be introduced unless careful planning is applied to all phases of the question.

Because of these considerations, the new Brown electrically operated flow meter would seem to deserve the special attention of all engineers interested in flow measurement, since by a novel, but thoroughly practical utilization of a well-known electrical principle, the design of the Brown electric flow meter at one stroke avoids all electrical as well as mechanical difficulties.

Six Features Listed

Among the characteristics of this new line of instruments are the following features:

1. The readings of the instrument are fundamentally independent of the value of the voltage impressed upon the electrical system. The instrument reads correctly, while operating on varying line voltages without the use of either voltage regulators or compensators.

2. The electrical circuits at the manometer, indicator and recorder consist simply of stationary, divided, inductance coils. These have only three connections which are permanently made at the time of installation. There are no make-and-break contacts.

3. In the manometer, or meter body, all electrical windings and connections are entirely external to the pressure chamber.

Electric Clock Control

4. The integrator is a mechanical device operated by the electric clock which is available for operating the integrator at all rates of flow, making possible the use of the most easily-read type of 5-figure counter for the integrator.

5. A pen operated by the action of the integrator mechanism makes a record at the outer edge of the chart each time the integrator mechanism increases the counter reading by one unit. Each tenth mark is distinguishable from the intermediate marks in order to facilitate counting when it is desirable to determine the total flow for a day or during any hours of the day, without having to watch the counter.

Compact Arrangement

6. The entire integrator mechanism with its individual recording pen is so simple and compact that it can be mounted in the standard recorder case along with the recording mechanism, thus avoiding the necessity of a separate integrator case.

The simple inductance bridge principle upon which all of these instruments operate, their freedom from troubles obviated by electrical connections that are permanent and external to the pressure chamber, their independence of voltage fluctuation, their automatic recording planimeters, the adaptability with which their manometers handle various ranges, their easy reading 5-figure integrating counters, the compactness of their operating units—the advantages of all of these va-

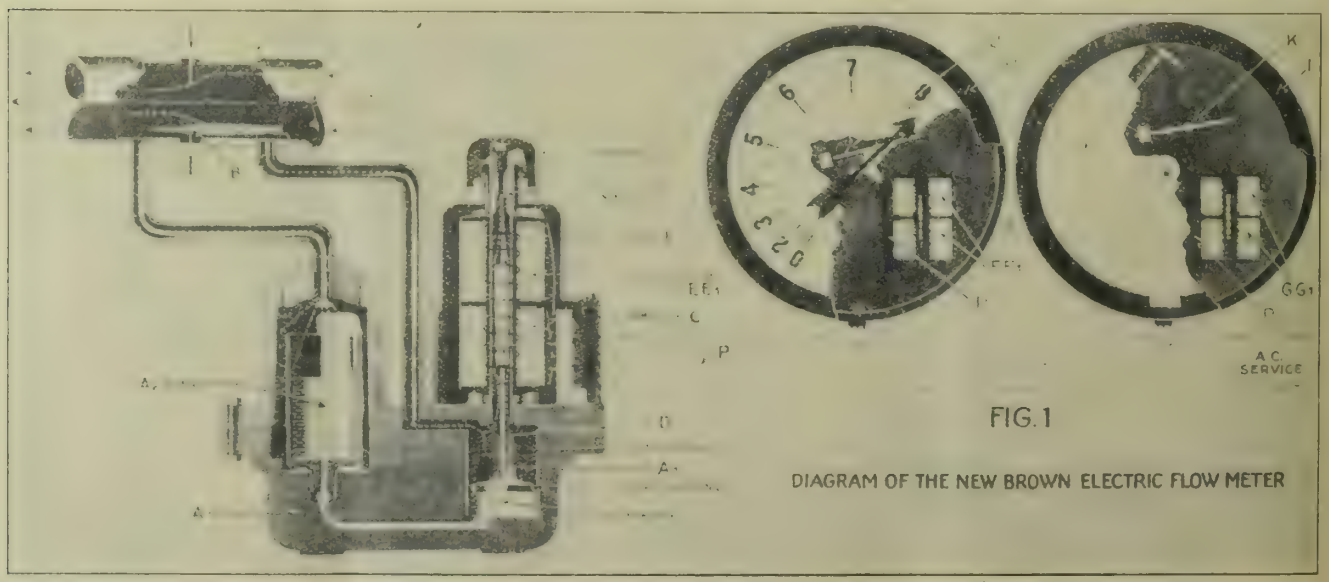


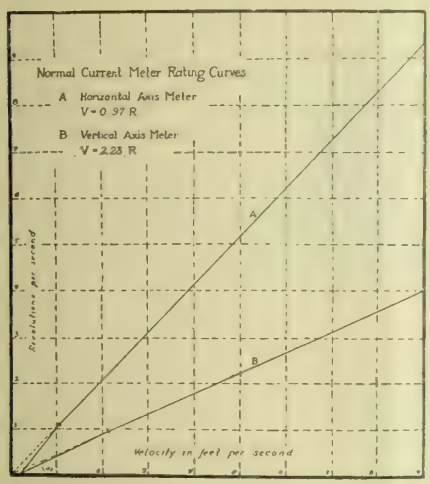
FIG. 1

DIAGRAM OF THE NEW BROWN ELECTRIC FLOW METER

rious features, the manufacturer asserts, make this new flow meter especially desirable for measuring the flow of steam, water, gas, air and other fluids, and of exceptional interest to all power plant and industrial engineers and officials concerned with such measurements.

Current Meter Notes

A recent survey of current meter literature revealed many references to rating


Normal Current Meter Rating Curves
A Horizontal Axis Meter
V = 0.97 R
B Vertical Axis Meter
V = 2.23 R
Revolutions per second
Velocity in feet per second

TYPICAL CURRENT METER RATING CURVES

curves in connection with developing the rating equations. No mention was made of the importance of the rating curve as a source of information concerning the efficiency, reliability and friction of meters.

Since necessity and desire for better and more economical work have increased the interest in current meters, it may be opportune to call attention to the benefits obtainable from an inspection of the meters and its rating curve.

The current meter rating curve is the graphic record of meter actions under definitely known water and operating conditions.

* * *

An efficient meter has a normal rating curve consisting of two sections whose merging point designates that velocity at which reliable meter work may be expected, as far as the meter itself is concerned. At low velocities, the opposing or negative forces such as friction, inertia, eddies and others are relatively strong; they interfere with regular meter actions. The meter indications under such circumstances can not be trusted.

The efficiency gauge for any meter is the distance of the merging point of the curve sections from the zero line, expressed in velocity per second. The shorter that distance the better the meter.

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Fig. 200

Fig. 180

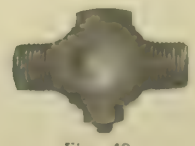
Fig. 40

Fig. 41

BRASS MATERIALS FOR WATER AND GAS

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A sluggish meter has a low sloped curve which indicates considerable stream disturbances. Such meter, if of large size, is laborious to operate and its indications are apt to be incorrect because the presence of the meter is materially changing the original stream flow to ascertain which is the primary object.

An active meter gives a rating curve of steep slope, suggesting high quality of meter work especially if the meter is small in size and in form stream-line. The original stream flow is but little disturbed by such meter and the meter operation requires but nominal manual effort.

* * *

Current meters may be classified by their individual rating curves. A normal curve is typical for all meters whose rotors are unprotected and unobstructedly exposed to the stream forces. It consists of a high and a low velocity section, the former being identical with the ideal curve (that curve obtained by rating an imaginary, perfectly frictionless meter, operated under ideal conditions). The normal curve permits the application of the ideal curve as a reference line, thus making it possible to discriminate between correct and faulty rating points.

Since not all rating stations are provided with indicating devices to give distance and time of meter travel and the meter revolutions automatically, it is more than likely that some of the rating points are erroneous.

It would be wrong to place such faulty points in line to determine the rating curve and the equation. All faulty points are exposed by the ideal curve, when it is applied as reference line.

* * *

Some meters are surrounded by frames and rotor protections, which invariably interfere with the free approach of the stream filaments and encourage eddy formations. Their rating curves are broken line curves and do not permit reference to the ideal curve. Their rotor action is the result of artificial water conditions created by a multitude of eddies. They do not indicate the original stream flow. Meters of this type are reliable only when stream conditions are perfectly identical to those under which they were rated.

* * *

A current meter rating curve does not indicate accuracy of meter work, it shows, however, the efficiency of the meter and gives that stream velocity at which the meter is expected to act reliably, providing the stream and operating conditions are favorable to good meter work. To determine this is left to to the ingenuity of the operator.

Frank J. Kimball Passes

Frank J. Kimball, for fifteen years president of the Frank J. Kimball Company, Los Angeles, passed away November 4 at his home in Los Angeles, following a chronic ailment of some years standing.

Active until a few days before his death, this well-known engineer and manufacturer had reached only the age of 52.

Born in Meridian, Mississippi, Mr. Kimball came to California in 1889 and immediately entered the field of engineering, particularly that branch relating to underground water supply.

F. J. Kimball

In the fifteen years of Mr. Kimball's continuous service as president of the company founded by him, he became widely known as an authority on water supply. He was an inventor of note, as is evidenced by the successful business he developed in the Kimball direct flow turbine pump, now used extensively wherever water is required from underground sources.

Mr. Kimball was a member of many engineering societies, and tendered his advice and support on many engineering projects for the country at large.

Engineering Details of Dam

(Continued from Page 13)

northwest corner of the property to be irrigated. Within the property, it runs about 15 miles farther, gradually narrowing from a capacity of 500 to 20 second feet at the southerly end.

At each section line, laterals are taken off, running east and carrying from 100 second feet down to 10 and finally 7.5 second feet in the sublaterals. Each sublateral runs to the high point of the quarter section which it serves.

The dam and diversion system were designed by C. E. Griggs, chief engineer of the district. They were then checked and approved a second time by Stone and Webster of Boston, before submission to the experts of the bonding houses which handled the securities.

Preliminary work in the development of an irrigation project near Needles, California, has begun with the shipping of casing and well supplies by G. P. Mohler to his holdings, and the sinking of a well on the land of H. K. LeClair. Work on other wells is to be begun shortly. It has been estimated that each of the wells will supply water enough for irrigating 100 acres of alfalfa.

The Progress of Irrigation

(*Continued from Page 10*)

$230,000 in 1935. This project under the program will be completed in 1935.

On the Belle Fourche, South Dakota, project $1,000,000 will be divided as follows: $125,000 in 1928, $250,000 in 1929, $250,000 in 1930, $250,000 in 1931, and $125,000 in 1932. Under the program this project will be completed in 1932.

A total of $12,400,000 will be spent to complete Echo reservoir and Weber Provo canal and other divisions distributed as follows: $1,240,000 in 1928, $1,000,000 in 1929, $760,000 in 1930, $1,400,000 in 1934, $2,000,000 in 1935, $2,000,000 in 1936, and $3,000,000 in 1937. At the end of the ten-year program this project will not be completed and it will be necessary to expend an additional $1,000,000 thereafter to complete it.

At Okanogan, Washington, $320,000 will be used to line laterals and complete pumping plant and the entire amount to be expended in 1929.

At Yakima, Washington, $25,579,000 has been apportioned for storage at Cle Elum reservoir and to complete construction of Roza, Kennewick, and Kittitas divisions. The expenditures on this project include $2,000,000 in 1928, $1,500,000 in 1929, $1,500,000 in 1930, $1,700,000 in 1931, $2,000,000 in 1932, $2,000,000 in 1933, $3,011,000 in 1934, $2,500,000 in 1935, $2,500,000 in 1936, and $2,500,000 in 1937. At the end of 1937 this project will not be entirely finished and an expenditure of $4,368,000 will be required thereafter.

A total of $5,195,000 will be spent to complete the Riverton, Wyo., project as follows: $600,000 in 1929, $600,000 in 1930, $500,000 in 1935, $2,000,000 in 1936 and $1,495,000 in 1937. Under the program this project will be completed in 1937.

The sum of $5,193,000 has been proposed for drainage on Garland division and distribution and drainage on Willwood division and completion of Heart Mountain division, Shoshone, Wyo., project divided as follows: $150,000 in 1928, $340,000 in 1929, $248,000 in 1930, $1,000,000 in 1935, $1,000,000 in 1936, $1,000,000 in 1937. Under the program this project will not be completed at the end of ten years and expenditures thereafter amounting to $1,455,000 will be necessary.

Watson Water Company of Romoland, Riverside County, has applied to the California Railroad Commission for a certificate of public convenience and necessity for the distribution of water in that district and for the establishment of rates for such service.

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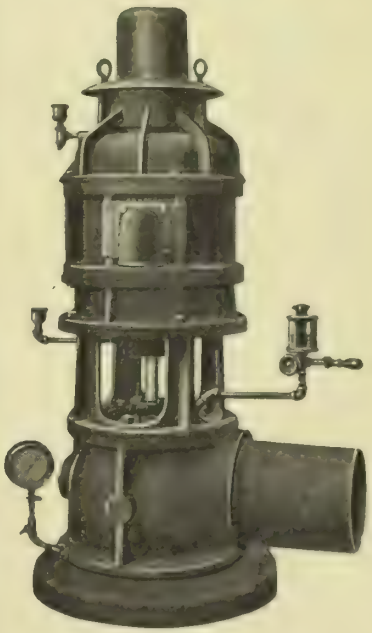

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WATER PURIFICATION

Southern Pacific Railroad's Experience With the Zeolite Treatment

By C. W. STURDEVANT

Assistant Engineer of Tests, Southern Pacific Company, San Francisco

DURING the past twelve to fifteen years considerable attention has been paid to the zeolite or "base exchange" method of water softening, especially for use in connection with laundries and stationary boilers, but practically no railroad, with the exception of the Southern Pacific Company, has made use of this treatment in connection with locomotive boilers.

The principle of zeolite treatment is that of base exchange, making use of base-exchange silicates possessing those properties by which they may combine with either the base sodium or the bases calcium or magnesium.

When regenerated, that is, ready to soften water, the mineral is possessed of a supply of base sodium in exchangeable form. During the softening run, this base sodium is replaced by the calcium and magnesium bases of the hard water.

When the supply of the base sodium is exhausted, that is, when the mineral has become possessed of its capacity of the calcium and magnesium bases, this softening action ceases. At this stage of the process the mineral is ready for regeneration, during which it is treated with a solution of sodium chloride (common salt). This salt is rather cheap and readily obtainable.

Regeneration Reverses Action

During the regeneration, the exchange of bases is exactly the reverse of that which takes place while softening water. At this time the base sodium of the salt is taken up by the mineral which gives up its load of the calcium and magnesium bases in exchange therefor. These hardening bases combine with the chloride of the salt solution which, during the regeneration, or salt brine flushing, is changed from sodium chloride to calcium chloride or magnesium chloride. These chlorides, being soluble, cause no sludge and are therefore flushed off through any convenient drain.

With the rapid-rate mineral now used by most of the manufacturers of zeolite water softeners, the time required for reconditioning of the zeolite mineral has been reduced to fifteen or twenty minutes. The two processes, softening water and then regenerating with salt brine, are repeated alternately with practically no loss to the mineral itself, during years of service.

This treatment is entirely independent of the actual water softening which does not take place while regeneration is going on; hence what excess of salt solution is required is simply washed away to the drain with the chloride of calcium and magnesium. The excess is never carried away in the treated or soft water.

During the base-exchange process of softening water, the exchange of bases, sodium for calcium and magnesium, is in the exact relation of the combining powers of these elements; therefore, overtreatment is impossible.

Factors Affecting Plant Size

The amount of zeolite mineral required is also proportional to the amount of water desired to treat between reconditioning periods coupled together with the incrusting content of the untreated water, as the converting power of the natural zeolite mineral, or green sand, is approximately 40 grains to the pound of mineral, under most favorable conditions, to 30 grains under ordinary operating conditions; consequently the size of the plant must have a certain amount of engineering in order to fit in with the variable local conditions.

The waters which are being treated on the Southern Pacific Company's lines are, by analysis, very similar to those found in other parts of the states and vary, naturally, as do waters elsewhere. At the present time, we are treating water varying from 11 grains of incrusting matter and 5.48 grains of soluble matter per gallon up to 33.94 grains of incrusting matter and 8.69 grains of soluble matter per gallon, and in one case, that of the El Centro, California, city supply, from the Colorado river, carrying 26.7 grains of incrusting matter as well as 20.58 grains of soluble salts.

In all cases the total incrusting matter is converted to soluble matter through the zeolite method of treatment, producing a zero-hardness water, with the exception of the silica, alumina and oxide of iron, which in ordinary cases range from one-half of one grain to say three grains per gallon. This, however, does no harm whatever nor does it form any scale in the absence of a binder, such as the calcium and magnesium carbonate and sulphate, which, as above stated, have been converted to sodium carbonate and sulphate.

However, this soluble matter produced by the treatment and added to the soluble matter originally contained in the untreated water, builds up a total of the combined soluble and insoluble matter, making what is ordinarily termed light water which always been feared due to the belief that much foaming and priming might result.

Again, fear of corrosion or pitting might be encountered.

Caustic Embrittlement Not a Factor

Also, as a result of said treatment, some have entertained the belief that caustic embrittlement might result. It is true that in some cases, where our locomotive boilers are badly scaled up, we do have a little trouble from foaming immediately after starting a zeolite plant. This is due to the fact that the salt water has a dissolving effect upon the old scale, producing a heavy sludge within the boiler and if not blown out regularly and rather often, foaming will result. However, if a reasonable amount of care is exercised in the handling of the blow-off cock, together with proper washing of the boiler, very little, if any trouble is encountered, and after a reasonably short time, most of the old scale will have disappeared and then such light water condition disappears.

So far as corrosion and pitting are concerned, we have paid particular attention to this and have even suspended pieces of new boiler plate, boiler tubes, steel wire, etc., in the boilers as close to the firesheet as possible and have left them in this position for from six months to a year, making inspections and tests after such time only to find material in original condition. We appreciate that even these tests are not the same or as severe as if the test pieces were a part of the firesheet or tube and therefor do not carry a convincing argument. However, we are still mindful of the possibility of above-mentioned after effects and are ever on the alert. So far, we have seen nothing to sustain the corrosion or pitting theory.

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*See Engineering News Record, Vol. 97, No. 1, p. 30.

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Bad Water Causes Epidemic

What is said by state health officials to be the most serious outbreak of typhoid fever which has occurred in any similar area in the state within the recent years broke out some weeks ago in Akron, New York, more than 200 persons out of a population of 2,000 having been ill with the disease. The State Health Department assigned two physicians and 10 health department nurses, the Erie County chapter of the Red Cross also sent ten nurses, and fifty private nurses have been employed for these cases.

There is said to be no question but that the epidemic is due to the water supply, which was known to be polluted but the use of which was continued, although an effort had been made to eliminate danger by the use of chlorination in 1920. The State Health Department had advised a safer supply and the local Chamber of Commerce had seconded this advice, but nothing came of it further than the installing of a chlorinating apparatus. During October the chlorinating apparatus had been out of order and its use was discontinued for several days and it is believed that most of the cases were due to the water drunk during that intermission of the chlorine treatment.

P. G. & E. Sells Water Supply Plants to New York Firm

Another wholesale transfer of water service properties was brought about through the recent sale by the Pacific Gas and Electric Company of all its water holdings to the Federal Water Service Corporation of New York, announcement of which was made on December 9. It was also stated that the Federal Corporation had purchased the Port Costa Water Service Corporation, formerly one of the holdings of the McNear estate.

In addition, C. T. Chenery of New York, president of the Federal Corpora-

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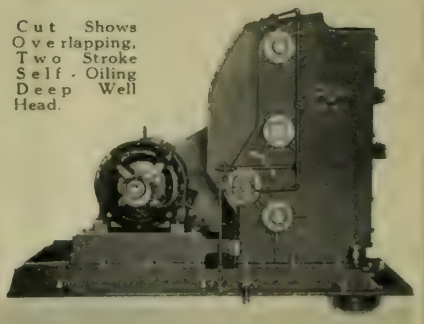

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tion, announced the recent purchase by his company of the water supply companies in Hermosa, Redondo, and Martinez.

Clean Up Field

The campaign of acquisition of Pacific Coast water companies was begun three months ago, it was disclosed, with the purchase by the Federal of the Fresno City Water Corporation, formerly owned by the San Joaquin Light and Power Company. Since that time the New York concern has acquired the independent water companies of Bakersfield, Visalia and Chico.

The water holdings of the Pacific Gas and Electric consisted of the six companies serving Stockton, Oroville, Willows, Redding, Dixon and Livermore. Their purchase will give the Federal 292 miles of water mains throughout the northern and central portions of the State and make it the largest exclusively water corporation in the United States, according to Chenery.

This is in line with the policy announced by the New York concern at its organization six months ago to acquire water property all along the Pacific Coast.

To Handle As One

Subject to the approval of the State Railroad Commission, the Federal plans to merge the fourteen California companies, the gross income of which is estimated to be in excess of $1,500,000 annually, into one operating organization to be known as the California Water Service Corporation, Chenery announced, which will be a subsidiary of the parent company in New York.

The Federal corporation already has acquired extensive water service holdings in the East, which have been similarly merged under the names of Union Water Service Corporation, West Virginia Water Service Corporation and New York Water Service Corporation.

Terms Not Stated

Prices and terms of the transfer of the Pacific Gas and Electric Company's water companies were not disclosed, but that several millions will change hands as a result of the deal is conceded.

C. B. Jackson, formerly general manager of the Fresno City Water Corporation, will be vice president and general manager of the California concern, Chenery said, while E. B. Walthall of Fresno will act as its secretary-treasurer. E. K. Barnum will be chief engineer.

McCutcheon, Olney, Mannon and Greene of San Francisco are counsel for the Federal Water Service Corporation in California and have handled the legal proceedings in connection with the transfers of the various water properties.

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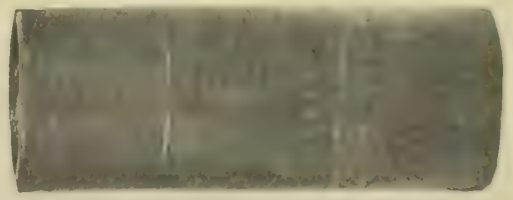

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SEWAGE DISPOSAL

Activated Sludge Processes and Their Recent Development in U. S. Cities

Pasadena, Lodi, Pomona and Folsom Prison Are Only California Localities With Activated Sludge Plants

By WALTER C. ROBERTS

*Director of the Pacific Engineering Laboratory of San Francisco**

THE early history of the activated sludge method of sewage disposal credits two American investigators, Black and Phelps, with doing the first experimental work on the aeration of sewage in 1910. In 1912 the Massachusetts State Board of Health at Lawrence, Mass., conducted laboratory experiments by aeration of sewage in gallon bottles, and later in a small tank. The chief result of these early experiments was to prove that aeration of sewage had a marked clarifying effect, and to greatly stimulate scientific interest in this method.

Dr. Fowler, in Manchester, England, began experiments in 1913 and was the first to show the real value of mixing previously aerated sludge with fresh sewage. Bartow and Mohlman at the University of Illinois in 1915 conducted somewhat similar experiments. The city of Milwaukee started investigations in 1914 under direction of Hatton and Copeland. The subsequent work at Milwaukee has contributed much to the present knowledge of the activated sludge process.

A few years later the city of Chicago started on a 250-million-dollar sewage disposal program and established a large experimental laboratory. A million-dollar experimental plant was built where the different types of equipment and methods of sewage disposal could be studied under actual working conditions.

England Leads Abroad

Two other cities have carried on extensive experimental work in connection with their activated sludge plants, Indianapolis, Indiana, and Houston, Texas.

Several European countries have carried on investigations on sewage disposal but in the field of activated sludge studies, England has the lead of other foreign countries. The English investigators have evolved new types of plants, three of which will be described later. They also use types of screens and other equipment not seen in this country. The cities of Manchester, Birmingham and Sheffield have conducted the most extensive investigations.

In Canada, particularly in the Province of Ontario, there have been several installations of activated sludge plants, mostly in small cities. These plants are reported as operating successfully, but there is a scarcity of data on their efficiency and operation costs that makes comparison with other plants difficult.

In California, the city of Pasadena, together with adjoining territory, built an activated sludge plant which was largely modeled after the Milwaukee plant. Lodi has an activated sludge plant of a similar type to the Pasadena plant. The principal difference is the method of sludge disposal. Another plant has recently been constructed at Pomona. The only other plant in operation in California is at the Folsom Prison.

Design Discussed

The U. S. Public Health Service has just completed a plant at the Grand Canyon, which is a very complete small plant. After filtering and chlorinating, the effluent meets drinking water standards.

Taking up now the different types of construction, we find that the usual design for activated sludge plants consists primarily of four units. First, some method for removing the coarser materials in the sewage; second, aeration tanks; third, a clarifier; and fourth, some arrangement for sludge disposal. Provision is also made for the return of a certain amount of sludge from the clarifier to the raw sewage entering the aeration tank.

The removal of the coarser materials eliminates substances which would require long periods of aeration and gives an influent entering the aeration tank which contains only finely divided substances. This removal is accomplished by the use of bar screens and grit chambers followed by the use either of fine screens or sedimentation basins. Bar screens consist of iron bars placed from a half inch to an inch apart and remove the large solid particles from the sewage. The grit chambers consist of broad channels in which the rate of flow of the sewage is reduced to about one cubic foot per second. These grit chambers follow the bar screens and remove gravel and other heavy solids.

Several Types of Screens

Several types of self cleaning fine screens are in use which will give a satisfactory influent for the aeration tanks. It has been found that rotating cylindrical screens with short beveled slots of not less than one-sixteenth of an inch in width give good results. This type of screen is preferred to a mesh screen. There is a tendency toward the choice of screens with a minimum of mechanical devices. Rotating cylindrical screens are used at Pasadena and Lodi. The use of settling basins for removing coarse solids is gaining favor. These have a smaller operating cost but larger initial cost than screening plants and take care of maximum flow conditions more easily. The use of Imhoff tanks as settling basins provides for the digestion of settleable material and offers an opportunity to return the excess activated sludge there for final digestion and de-watering. Dorr clarifiers are used as settling basins at the new North Side plant at Chicago. An Imhoff tank is to be used at the new Pomona plant.

The period of detention in the settling basins and in the Imhoff tanks is the same and varies with the nature of the sewage. It is usually about an hour.

In the aeration tanks there are two principal methods of maintaining aerobic conditions in the sewage, one by agitation with air and the other by agitation with mechanical devices.

Aeration Tanks Described

The aeration tanks for air agitation are rectangular with wide variations in dimensions, being built from 12-20 feet in width, from 70-300 feet in length and from 7-16 feet in depth. Air agitation is usually accomplished by forcing air under pressure through porous plates laid in rows at the bottoms of the tanks. The compressed air is furnished by power blowers capable of about 10 pounds pressure. The pressure necessary is but little more than sufficient to force the air through the plates. The plates occasionally become partially clogged, requir-

*An address delivered before the League of California Municipalities at their 28th annual convention, August 16, 1926.

ing greater air pressure and may eventually need to be replaced. The air for the blower is filtered through air filters to remove any substances that would clog the plates. There are two general types of aeration tanks, the "ridge and furrow," and the "Manchester or circulating." The ridge and furrow type has the rows of plates perpendicular to the length of the tanks, each row being separated from the next by a ridge. The ridges prevent the settling of the sludge other than over the plates, where it is caught again in the rising current. The area of the porous plates is from one-fifth to one-tenth of the surface area of the liquid. This type of tank is in use at Pasadena and Lodi.

The Manchester or circulating type of tank has the plates arranged only along one longitudinal side of the tank which arrangement, with the aid of sloping baffles at the top and bottom, produces a rotating motion of the liquid. This method requires fewer plates, slightly less air, and mixes the sewage and sludge more thoroughly than in the ridge and furrow type. There is also the advantage of cheaper construction, lower power costs, and cheaper upkeep. The circulating type of tank is used at Manchester, England, Indianapolis, Indiana, and will be used in the huge new North Side plant at Chicago, and in the new Pomona, California, plant. The amount of air required depends on several variable factors, but is usually about 1.5 cubic feet of air per gallon of liquid treated. The Lodi plant has an enviable record in being able to use what is probably the lowest amount of air per gallon of sewage of any plant keeping authentic records. During most of the year the air consumption is reported at from .6 to 1.0 cubic feet of air per gallon of sewage.

The detention period for the sewage in the aeration tanks is about six hours for both the "ridge and furrow" and the Manchester tanks.

Reconditioning Tanks

The sludge which is returned to the incoming sewage, is frequently reaerated or "reconditioned" in separate aeration tanks before it is used. These reconditioning tanks are usually similar in construction to the other aeration tanks. All conveying channels for both fresh and treated sewage are usually built with porous plates in the bottoms to permit a constant aeration and to prevent the settling out of solids which might start septic action.

Experiments with the air diffusion type of plants indicate that oxygen is most rapidly dissolved from the air as the bubbles break on the surface of the tank and dissolves much more slowly as the bubbles rise through the liquid. The

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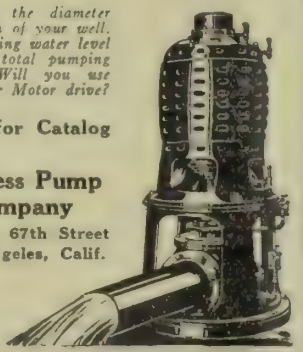

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main function of the rising bubbles is therefore to agitate and mix the sewage and the added sludge. It seemed possible that some mechanical method of mixing and surfacing aeration could be found that would be as successful as air diffusion and easier and cheaper to operate. This has resulted in the manufacturing of different devices for this purpose. At least two of these are worthy of description.

A plant at Sheffield, England, circulates the sewage through narrow and comparatively shallow parallel channels arranged like cross baffles. Paddle wheels in each channel give the sewage an undulating motion similar to that seen in the water behind a stern wheel steamer, the wheels also give the liquid the same frothy appearance. The speed of the current is sufficient to prevent settlement and the length of the channels is such that the undulating motion is continuous. This type of tank is claimed to be economical and successful but has not been widely adopted. There is no plant of this type of operation in the United States.

Simplex Type Described

The "Simplex" type of mechanical aerator consists of an upright iron cylinder approximately twelve feet long and two and a half feet in diameter. This is set on legs in the bottom of a hopper bottom tank with about a six-inch clearance, which permits a free circulation of the liquid into the cylinder. Over the cylinder but not attached to it, is a revolving inverted cone about five feet across, the upper side of which is fitted with curved blades on edge. An opening is cut in the inverted apex of the cone the size of the cylinder. The cone is about the level of the liquid and throws it out in a spray drawing it up from the bottom of the tank through the cylinder. When the spray strikes the surface of the liquid, additional agitation is secured. The cone is driven from a power unit by a shaft which can be extended to run a series of aeration units. This type of plant has given satisfactory results experimentally in Chicago, and Decatur, Illinois, and under operating conditions in a small city in Texas, and a unit is to be installed in California this year. The Simplex system has been installed in several British disposal plants and is being installed in a few American cities.

The clarifier following digestion makes it possible to decant the clear liquid and collect the sludge. Plain basins with steep hopper bottoms are used, but flatter bottoms with a mechanical device for scraping or squeegeeing the sludge to the center such as used in the Dorr clarifier, are more com-

(*Continued on Page 52*)

New Post for Stumm

R. A. Stumm, who is well known to the various California public utilities through his connections with the Paraffine Company, Inc., has recently become indentified with the Los Angeles Manufacturing Company of Los Angeles. Mr. Stumm has followed engineering sales work for a great many years, and has formed a host of friends up and down the Pacific Coast, both in the various public utility companies, and in the oil companies.

R. A. Stumm

The Los Angeles Manufacturing Company is one of the few pioneer organizations of Los Angeles, being formed in 1902. It has progressed very steadily in its growth, and today ranks as one of the largest of its kind in Southern California. It specializes in the fabrication of riveted and welded steel pipe for all classes of work including water supply systems and irrigation. Mr. Stumm assumed his duties December 1.

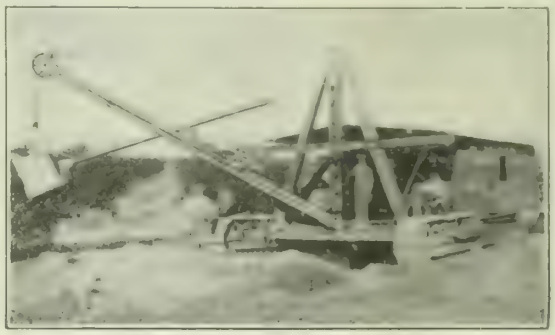
United Concrete Moves to L. A.

The United Concrete Pipe and Construction Company has recently moved its general offices from Merced to Los Angeles, with headquarters in the Chamber of Commerce Building, telephone Westmore 2338. The branch offices of the company at Sacramento, Merced, Ventura, Woodland, and Delhi will still be maintained. The main plant is located at Compton, California.

For Cleanout -- Maintenance -- New Ditches

There's a Bay City for Every Job

BAY CITY Land Dredges span the ditch, can dig any desired slope, and dump waste on both banks. BAY CITIES leave clean, wide berms, and can work up or down streams. One trip over the ditch is enough. The Shovel Type Dipper handles hard material in which other types of buckets cannot make a good showing.



At left—One yard BAY CITY Dredge digging and cleaning ditches in Florida Citrus Groves.

BAY CITY Land Dipper Dredges are built to fit the job. Walking, Crawler, Track or Floating mounting. Easily dismantled, transported and assembled. Capacities ½ to 1½ cubic yards. Oil engine or electric operation.

FOR SMALLER DITCHES — OR PIPE LINE TRENCHES

The BAY CITY 16-B convertible Excavator will handle a wide range of work. Operates Dragline, Trench Shovel, Clamshell or Skimmer. All steel. Shipped assembled. Digs any width or depth up to 20 feet.

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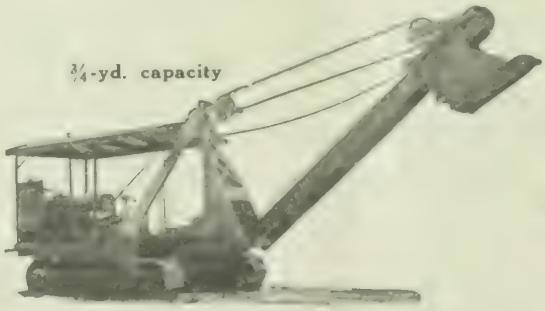

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or—Model 4 Excavator

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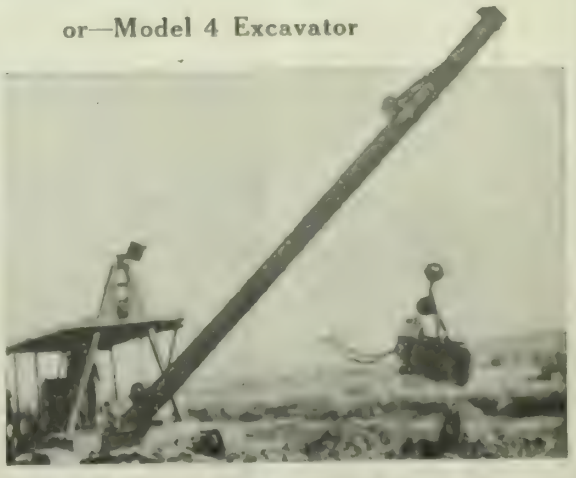

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Problems of a Sub-Surface Water Supply

(*Continued from Page 27*)

the Rancho de Kaweah, and conveying it to lands within its boundaries for irrigation and domestic use. Briefly stated, the complaint alleged: That the underground water body in the Rancho de Kaweah is a part of the Kaweah River as the same passes over the Rancho, by lowering this underground body of water which, it was alleged, supported the surface flow.

The stand of the defendant, briefly, was: That there was and is a surplus of water over and above the reasonable needs of all the plaintiffs, allowing for ditch seepage and thorough irrigation of approximately 100,000 acres shown to have been irrigated. All of the principles of law applicable to water and the use thereof were involved in this case. The plaintiffs included in their number riparian owners, overlying land owners and appropriators from natural streams. The right of ditch owners to water lost by seepage from the ditches; the right of overlying land owners to underground waters built up by natural streams; the rights of riparian owners as effected by the "Water Commission Act of 1913," were argued and considered. I should know considerable on this subject after ten years of litigation, and the study of a collection of field data that treats on it from every angle. As a result, but one thought is uppermost in my mind: It is that underground water is and will be for many years to come an important factor in making possible the irrigation of large areas in California.

Two Years Delay

As I said, the complaint was filed July, 1916, and the trial began October, 1917, before Judge Wallace in the Superior Court of Tulare County. It closed after 16 days of argument, in May, 1919. The court gave its opinion in favor of the plaintiffs in July, 1919. The Supreme Court of the State was asked for a writ of prohibition, to prevent the entry of a judgment in accordance with the opinion, on grounds that the judge was an interested party, he having a small lot underlaid with the same body of water that the dispute was about. The writ was granted, and all proceedings to that date were declared invalid. Judge Jones of Nevada was called in, and he made an order requesting the Governor to appoint a Judge outside the county to hear the case. Judge Kinsell of Oakland was appointed, was taken ill after hearing a few motions, and resigned.

Then the Hon. Peter J. Shields of Sacramento was appointed, but on account of pressing business in his court, could not serve. Then Judge William M. Finch was appointed and accepted. The trial of the case proceeded before him for about four weeks, when he was offered a seat on the District Court of Appeals, Third Appellate District. This he accepted and withdrew from the case. During Judge Finch's stay on the bench, he repeatedly urged a compromise and even said the means were not lacking whereby this could be done. Judge Seawell of Oakland was then appointed and accepted, but after a brief stay found that his wife had relatives that had land in our district, and retired. Judge Albert Lee Stephens of Los Angeles was next appointed and accepted the task of trying the case.

After almost two years' delay, the case was opened November, 1921, with Judge Stephens presiding. The trial closed July 31, 1923.

Perpetual Injunction Ordered

Final arguments were made in Los Angeles in December, 1923, and Judge Stephens issued a memoranda opinion in May, 1924. Findings of fact and conclusions of law were filed in May, 1925; ordering the issuance of a perpetual injunction against the Lindsay Strathmore Irrigation District. In April, 1926, the judgment was filed, and concurrently therewith an order suspending the operation of the injunction, on terms, pending an appeal to the Supreme Court which the Lindsay District announced it would take. At the time the findings were filed in May, 1925, the attorneys for the district made a motion for an order suspending the injunction pending the appeal. Judge Stephens made an informal announcement that he would grant the motion. The plaintiffs then asked the Supreme Court for a writ of prohibition to prevent the entry of such order. This matter was argued before the Supreme Court En Bank at Los Angeles. That court three months later denied the writ.

The case is now in the Supreme Court on appeal. The record on appeal consists of 25,000 pages of transcript, over 700 exhibits and the judgment roll, which comprises 900 printed pages. The cost has been, including both sides, close to a million dollars. There has been some criticism of the length of this trial, but I wish to show to this convention, that our people are very grateful that we have been able to hold the water during this period. We have had an opportunity to strengthen our position during the past two years, by the acquisition of water stock in mutual water companies and corporations diverting water from the Kaweah River. This water stock represents an amount of water in acre feet, 50 per cent greater than any amount pumped in any one year by our district, and we are now devising ways and means of using this water, if our appeal to the Supreme Court is not successful.

The Lindsay District has one of the most modern irrigating systems which is based on a high duty of water. Thirty-nine pumping plants are located on the Rancho de Kaweah; about 20 miles of redwood pipe, 14 inches to 48 inches in diameter, lead from the rancho to a low line cemented canal, six miles long; this canal conveys the water to the main pumping station, three miles north of Lindsay. The total lift at the rancho is about 120 feet to the main pumping station; there it is boosted 162 feet to a gunite bench flume 6 miles in length. From this flume the water is taken out and distributed over the district by means of 100 miles of riveted steel pipe, varying in diameter from 4 to 36 inches, and is delivered to the consumers under pressures varying from 0 to 75 pounds.

The same supply is used for both domestic and irrigation purposes. At the end of the bench flume, two steel lines lead off, one 30 inches and another 36 inches in diameter. The first 4 miles in length supplies a second small booster station where another lift of 160 feet is made to serve 2000 acres on a higher elevation. At this last lift the water is place in a small cement canal three miles long and is distributed therefrom by steel lines. The system is 100 per cent metered, with loss from all sources of about 4 per cent. This includes the loss by metering as a whole at the source and distributing in small amounts.

Water Is All Metered

Our people like the meter system, and I am a firm believer that where individuals own their own plants the water should be metered, so that they can tell the amount used and have some idea that the application of water is near the amount needed for the crops being raised. The irrigation rate is $10.00 per acre foot and the domestic rate $20.00 per acre foot. This money is used on operation only, while bond interest and general funds are paid from direct taxes on all lands, the rate being the same on improved and unimproved lands. The average cost of water per acre which includes everything, including litigation, is about $26.00 per acre.

The balancing feature is taken care of by a small reservoir holding 20 acre feet, located about one-quarter mile beyond the last pumping station, and 25 feet higher. The pumps are connected with the line going to the reservoir, and the surplus, if any, goes by. If a short-

tage exists the same line carries the water back.

The irrigation season normally is about 210 days, depending greatly on the rainfall, and water use is based on a high duty and economic handling. The duty is about 1.6 acre feet per year. A certain amount is allowed per acre each thirty-day period, and the consumer is usually permitted to take the same in heads as needed. Very few services take as high as 35-inch heads, the average being about 15 inches. Our connected electric load is 3750 H.P., yearly use over 10,000,000 KWH, and the rate is about .8 of a cent per KWH and voltage on all motors 2200.

Many Interesting Problems

We have had some very interesting problems to meet in the operating features, especialy in the control and eradication of algae. If any one is interested I would be glad to answer their questions. The gunite bench flume is a unique piece of construction. I have a plan of it here on the wall and also a few pictures which may also be of interest to others.

The experience of the last ten years with the affairs of the Lindsay Strathmore District has caused me to form the opinion that no more dependable supply of water for irrigation purposes can be obtained, than that from underground basins. Nature has created many such natural reservoirs in California, of which that tapped by the Lindsay District is probably the best. The rains of the fall and winter, and the snow flow of the spring and early summer, are rapidly absorbed, and as rapidly extracted by the pumps. The rate of underground lateral percolation is so slow—about six feet a day—that little water escapes. In a climate where evaporation from water surface is so great—from 5 to 7 feet per annum,—the storing of water underground completely salvages this loss, provided the water table in the sands and gravels is not less than four feet below the surface. In my opinion the most economical method of conserving water is to take advantage of these natural storage basins, and by causing the surface flow of the streams to pass over wider areas, increase the absorption thereby. No more economical and permanent source of supply can be obtained.

Open Kansas City Office

The Barber-Greene Company has opened a new office in Kansas City, Missouri, at 2045 Main street. E. H. Cooper, district manager of the Barber-Greene Company will be in charge.

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LEGAL *and* JUDICIAL

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Colorado Rules on Disputed Election of Officers

Quo warranto held to be proper proceeding to oust officers of irrigation district.

The Divide Irrigation District of Colorado held an annual election to elect two directors, one for a vacancy and one as a successor to Canning who was president and director. At the election the relators were elected and the secretary so notified them, but that the old Board (Lockard and Canning) were in doubt as to the legality of the election, and the Board refused to issue a Certificate of Election.

The proceeding by way of quo warranto was commenced and in the case of Lockard vs. People ex rel. Hasselbush et al. 250 Pac. Rep. 152 (July 6th, 1926) the Supreme Court of Colorado held that this proceeding was proper to test the right to the offices, stating:

Newly elected directors as residents of the state and irrigation district, and claiming to be lawfully elected directors, *held* entitled to join in action in quo warranto to oust from office President and Secretary of the District who were trying to extend their own tenure of office and withholding certificate of election from relators.

Washington Supreme Court Defines "Reasonable Diligence"

Sets forth law of water rights as between appropriator and riparian owner.

In the case of Hunter Land Co. vs. Laugenour, 250 Pac. 41 (October 21, 1926) the Supreme Court of Washington considers many questions concerning the law of waters of that state. The controversy involved the rights of the various claimants to the waters of a stream known as Hunter Creek.

On the point of "reasonable diligence" the Court states:

"The evidence leaves but little doubt that the construction of the ditch by which the water was diverted was commenced in the year 1883 and completed in the year 1885. The rule is that when the actual diversion of water to a beneficial use on land is at a time later than the work of constructing the means by which it is diverted is begun, the time of diversion relates back to the beginning of the work only when the work has been pursued with reasonable diligence, so that the real question is, was the work in this instance pursued with reasonable diligence? It is our opinion that it was. The ditch was some 2½ miles in length, and for a part of the way it required the construction of a flume. The work of construction was thus of considerable magnitude, and it would seem that from the very nature of the work there was no lack of diligence. In addition to this, it was shown that Hunter was industrious and energetic and devoted his entire time to the work of developing his property.

Also on the question of the water rights as between appropriator and riparian owner and as between several riparian owners the Court sets forth the law as applied in Washington, as follow:

That lands of settlers are non-riparian does not affect water rights acquired by appropriation.

Private ownership of lands riparian to stream does not prevent appropriation of water for irrigation purposes for non-riparian lands.

All water rights, not attaching as riparian right to lands privately owned, may be appropriated by owners of other lands.

Riparian owners have coequal rights to use water for purposes of irrigation, notwithstanding settlement by one of them antedated the other.

Riparian right is not equivalent of right by appropriation, and cannot be exercised to exhaustion of waters, though needs of land require it, in disregard of rights of other riparian owners.

Riparian claimant, as against subsequent appropriator, has only right to take for irrigating purposes such proportion of water as his riparian land bears to quantity of riparian lands on stream capable of irrigation.

Another point of interest in this case is the remarks of the Court concerning the limitation of Riparian rights to "reasonable use." On this point the Court states:

The decision recognized our previously announced rule that a reasonable use of the waters of a stream for the purposes of irrigation was a right attaching to riparian ownership, and deduced therefrom the further rule that where all of the lands riparian to a stream were in private ownership, and where a reasonable use of the water for irrigation purposes by the riparian owners exhausted the supply of water the stream afforded, there was no room for an appropriation.

Montana Supreme Court Sets Limit as to Water Rights

When one has all the water required, or all his ditches can carry, his right to a greater flow is immaterial.

In the case of Tucker vs. Missoula Light & Water Co., 250 Pac. Rep. 11. (October 4th, 1926) the plaintiff recovers a judgment for the sum of $22,726.90 damages against defendant for the wrongful and unlawful diversion and use of water by defendant. The defendant in its answer sets up a prior right and also a defense based upon the fact that no water commissioner was appointed for the stream.

In affirming the judgment of the trial court the Supreme Court of Montana passes upon several points of interest.

As to the defense that no water commissioner had been appointed, the Court says:

Counsel for defendant asserts that the water code of Montana is "so complete a remedy for all water uses and for all wrongful uses of water on an adjudicated stream that it seems self-evident that the Legislative Assembly ... intended and designed this code as an exclusive remedy." We do not so view the statutes to which reference is made. A special statutory remedy is not exclusive, unless such intention is clearly manifest. It is merely cumulative, unless a contrary intention clearly appears and it cannot be otherwise than cumulative unless it is entirely adequate for the protection of pre-existing rights —The right to sue for damages for the invasion of a right existed under the common law, and exists under our code ... and the statutory remedy referred to by counsel must, if it is to supersede such right of action, be entirely adequate to protect the rights of owners of decreed rights at all time. It is therefore manifest that the remedy provided for (Code) is but cumulative.

On the question of the amount of water to which each of the parties was entitled, the Court quotes the following general rules of law:

The so-called "ownership" of water differs from that of personal property capable of corporeal possession. Neither the appropriator of water nor one to which a right is decreed owns the corpus of any part of the flow of the stream. He is entitled only to the beneficial use of the amount of water called for by his appropriation or decree when he has need therefor, and providing his distributing system has a sufficient capacity to carry such an amount of water. When his ditches are incapable of carrying the amount of water decreed to him, his right is measured by the capacity of his system of distribution, regardless of his needs. So long as a party has all the water his necessity requires or that his ditches will carry, it is immaterial that he has a right, under decree or otherwise, to a greater flow from the creek. It is his duty to permit the excess to remain in the creek or, having diverted it, to return it to the creek in such manner that it will be available to subsequent appropriators or decreed rights.

On the question of the amount of damages awarded, the defendant claimed that the same were excessive. On this

(*Continued on Page 55*)

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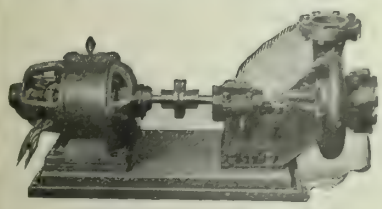

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OVERHEAD IRRIGATION

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HOW TO GET THE BEST COVERAGE WITH "OVERHEAD"

By H. A. WADSWORTH

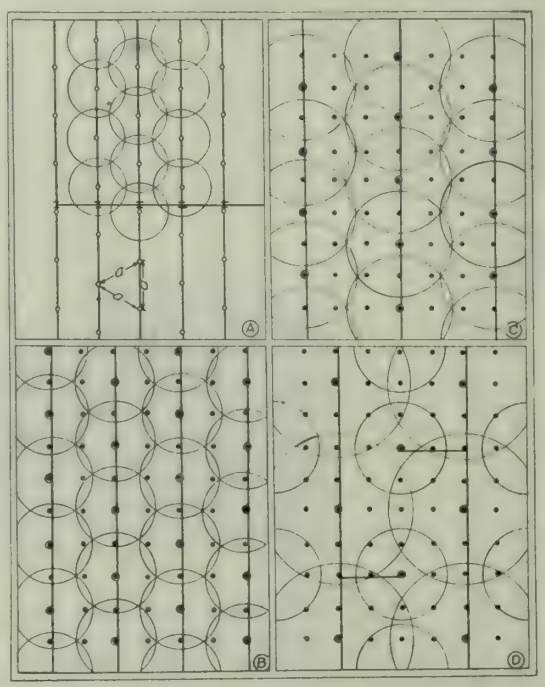
SPRINKLER installations for orchards, nurseries, and truck gardens fall into two general classes: perforated overhead pipes, sometimes called overhead nozzle lines, and revolving sprinkler systems which water circular areas.

Sprinkling heads cannot distribute water over a given rectangular area as uniformly as a well operated sprinkler line because of the overlap of the circles of application which are necessary to insure complete coverage. With field crops, nursery plantings, and truck crops, where the location of sprinklers is not rather rigidly fixed by planting arrangement, part of this objection can be obviated. When sprinkler heads can be located on a hexagonal pattern and every head placed at an equal distance from every other head adjacent to it, only about 15 per cent of the area served will be within the zones of overlap, provided the spacing to the spread which can be expected from a single head.

Location of Sprinkler Heads

In cases where the location of the heads cannot conform to a true hexagonal spacing because of the planting scheme—or for some other reason—the amount of overlap must be increased if complete coverage is provided. No real objection is offered by this necessary overlap, since all sprinkler heads throw less water to the extreme circumference of the circle of coverage than is applied to the central area. The overlap tends to equalize any lack of uniformity of application which may result from a single head.

Many commercial sprinkler heads now on the market throw water with fair uniformity over a circle with a 60-foot diameter when a pressure of from 15 to 18 pounds per square inch is available at the head. With an expected diameter of coverage of 60 feet, sprinkler heads should be located so that each head is 52 feet from its neighbors in every direction. Such a spacing can be effected by staggering the sprinkler heads on feed lines which are parallel and which are 45 feet apart. This plan of installation is evidently impossible in orchards that are planted on the rectangular system. Several plans of layout are shown in figure 1. In this figure, plan A is a hexagonal installation for truck gardens, nurseries, or for orchards planted on the hexagonal plan. Plans B, C, and D are superimposed upon rectangular orchard plantings.



LAYOUTS OF PERMANENT SPRINKLER INSTALLATIONS

A. A hexagonal installation reduces the overlap of circles of coverage to a minimum. Each head is the same distance from its neighbors in every direction. Such a method of installation is not adapted to orchards on a rectangular planting plan.

B. A common method of installation in rectangular plantings is to establish a sprinkler head in every second tree in every second row. The sprinkler heads are not equally spaced.

C. Economy in underground piping results when individual sprinklers can be located in every second tree in every third row. The distribution is lacking in uniformity.

D. When sprinklers of large diameters of coverage are used auxiliary sprinklers are sometimes installed to insure complete coverage without excessive overlap

In orchards set on the rectangular plan, with 24-foot spacings, a close approximation to the ideal installation suggested above can be reached by establishing sprinkler heads in alternate trees in alternate rows. When such a scheme is adopted, the diameter of a single circle of coverage must be two and one-half times the distance between trees, if complete coverage is to be obtained with a minimum of overlap. Under the condition given the diameter required for most efficient coverage is 60 feet.

Some growers object to locating heads directly over a tree. The accumulation of excess water at the trunk of the tree, because of unavoidable leaks in the sprinkler heads, and the difficulty of handling fumigation tents over trees equipped with sprinkling stands, are given as criticisms of this method. Growers who disapprove of such an arrangement sometimes install sprinklers in the centers of the tree squares. The diameter of coverage is the same in either case. Some obstruction to cultivation must be caused by an installation in which the sprinkler pipes rise from the centers of the tree squares. must be allowed to obtain complete coverage. If sprinkler heads are placed in every third tree in every second row, the circle of applica-

Special Heads Cause Overlap

Some types of sprinkler heads are designed for greater coverage than the 60-foot diameter usually served by the more common heads. It is difficult to use these special heads advantageously in orchards on common spacings, because of the unavoidable overlap which

(*Continued on Page 55*)

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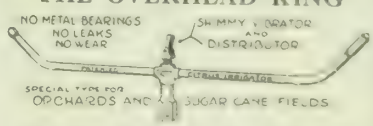

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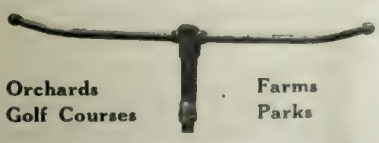

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Excavator's Performance Recorded

The Parsons Company of Newton, Iowa, has recently placed one of their Model 21 Special Irrigation, Serial 829 trench excavators with the United Concrete Pipe & Construction Company, Los Angeles. This machine has been used by the purchasers on quite a few of their new jobs. A log of the operations has been kept upon some of the work and is given herewith:

Date	Size	Gasoline	Oil	Running Time	Lin. Ft. of Trench	Remarks
Oct. 26	30"x40"	20	1½ qts.	5 hours	780'	Clay Loam includes 2 miles walk under own Power
Oct. 27	30"x40"	12	2 qts.	5 15 min.	630'	Clay Loam installed grading Devise
Oct. 28	30"x40")			6 15 min.	528')	Clay Loam changed teeth on Cutters
Oct. 28	28"x40")	15	2 qts.		720')	
Oct. 29	28"x40")			6 15 min.	1320')	
Oct. 29	28"x55")	15	1 qt.		104')	Clay Loam
Oct. 30	28"x55")			5 15 min.	518')	
Oct. 30	28"x40")	15	2 qts.		682')	Clay Loam
		77 gal.	8½ qts.	27 hrs.	5352'	
Nov. 1 moved 9 miles to new job						
Nov. 2	30"x63")			6 15 min.	400')	
Nov. 2	30"x44")	15	2 qts.		600')	Light Dobie
Nov. 3	30"x44"	15	1 qt.	2 30 min.	450'	Fixed bearing on Conveyor
Nov. 4	30"x44"	10	1 qt.	3 0 min.	550'	Changed type of teeth
Nov. 5	30"x44"	10	1 qt.	5 0 min.	700'	Wet Dobie soil
Nov. 6	30"x44"	5	0 qts.	1 45 min	250'	Wet Dobie—Changing cutters, etc.
Nov. 8	32"x43"	12	1 qt.	5 30 min.	450'	Wet Dobie—Experimenting on teeth
Nov. 9	32"x55½"	17	1 qt.	6 30 min.	1000'	Dry Dobie and Clay Loam
		84 gal.	7 qts.	30½ hrs.	4400'	

Development of Activated Sludge Process

(*Continued from Page 44*)

monly found. The period of detention is from one to four hours.

Sludge Disposal Problem

The collected sludge contains 98-99.5 per cent of water and is easily handled by air lifts, pumps, or some type of ejector. A portion is returned to the sewage influent and the remainder to the sludge disposal system. The amount of sludge found necessary to return to the aeration tanks for best results varies from 12.25 per cent of sludge by volume. This amount can only be determined by experiment and is usually about 20 per cent.

The satisfactory disposal of the sludge produced by the activated sludge process offers, perhaps, the biggest problem found in such plants. The sludge from the clarifiers is a brown flocculent mass of organic matter of high bacterial content. It is slow to dry on sand beds, does not filter easily, and is difficult to handle in artificial driers. Efforts to get it into a form that can be readily sold as fertilizer, have not met with much success without excessive costs. A large amount of work has been done at Milwaukee, Chicago, Houston, and elsewhere in an effort to make this an economic possibility. Various mechanical filters have been tried in an effort to get sludge in a condition in which it can be readily dried.

The treatment of the sludge with various chemicals such as sulphur dioxide, sulphuric acid, alum and ferrous sulphate has been tried in hopes of increasing its rate of filtration and has met with varying success. It is found that sludges from different sewages react differently under the same treatment. In the arid and semi-arid regions of the Pacific Coast it is likely that sand drying beds will be successful. This method has been used with good results at Lodi. The sludge must be placed in much shallower depths than would be used with Imhoff sludge. The method of sludge disposal in use at Indianapolis and Houston is to pump the sludge to large lagoons. The lagoons are usually underdrained. The sludge decomposes and partially dries with some odor and is flushed into a nearby stream during high water. Another method is to use the sludge for direct irrigation on agricultural land. Perhaps the most promising method is to digest the sludge, after mixing it with the coarse material taken out by preliminary treatment in Imhoff tanks. This not only offers a method for disposal of the coarse material but dewaters the sludge so that it can be more readily dried on sand beds. This causes the loss of some of the fertilizing value and greatly increases the initial cost of the plant. Researches have indicated that two or three times as much sludge capacity is required as is necessary in an Imhoff installation without activation.

Increasing Filter Capacity

The use of activated sludge plants as a preliminary treatment for sprinkling filters offers a promising future. The effect is to relieve the load of the filters, thereby increasing the filter capacity.

Surprisingly large increases are possible in the dosage applied to the filters by the use of only limited detention periods in the aeration tanks. This makes it possible to supplement sprinkling filter systems with standby activated sludge units for use during peak periods. These periods of high flow are common in California as in resort cities having a large seasonal fluctuation in population, and in cities with seasonal industries such as canneries and packing houses.

The sanitary disposal of the trade wastes from many industrial plants is one of the biggest problems of the sanitary engineer. The advent of the activated sludge process and its application to trade waste problems, has opened up a new field for investigation. It is found that some of the wastes can be successfully treated by this method if fixed with domestic sewage, but not if treated separately without excessive costs for chemical precipitation. This again, is a problem which varies with individual plants and must be solved by local study of each particular trade waste.

There is no doubt but that the trade waste problems of many cities could be solved by properly designed activated sludge plants and that further studies will perfect methods for treatment of wastes not at present successfully treated.

The comparatively high cost of activated sludge plants has been one of the main objections to their adoption. The mechanical types show a power economy and require less labor attendance. So far, data on the depreciation charges for this type are too meager to warrant any definite conclusions. It would seem that some form of mechanical aeration eventually will be found that will be the most economical form of activated sludge plant, especially for small installations.

The initial cost of an activated sludge plant is no greater than that of other methods giving as high grade of effluent.

The higher operating cost of activated sludge plants over other methods is due to more mechanical devices, higher power cost, and a greater labor overhead. The cost per million gallons, including depreciation, interest, labor, power, etc., has been found to run from $20 to $50 in the few plants where data are available. The initial cost of the plants varies from $10 to $30 per capita.

The wide variation in these cost figures serves to emphasize the fact that each municipality has a separate sewage disposal problem of its own and that cost data of other cities may not be at all applicable. Thorough preliminary investigation is necessary to economically design a sewage disposal system, whether it be an activated sludge plant, or one of the other types.

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SURVEY *of* HYDRAULIC DEVELOPMENT

As Shown by Official Records of the Month -- Local, State, and Governmental

Applications Filed

Among the applications for permit to appropriate water filed with the State Department of Public Works, Division of Water Rights (California), during the month of November, 1926, were the following:

Application No. 5263 (San Bernardino County—Noah Adair, c/o David W. Richards, attorney, 218 Katz Bldg., San Bernardino, Calif., for 0.67 cubic foot per second from a spring tributary to Cajon Canyon to be diverted in Sec. 32, T 2 N, R 5 W, S. B. M. for agricultural purposes on 10 acres. Estimated cost $500.

Application No. 5265 (Butte County)—Walter J. O'Neill, c/o Polk & Robinson, Chico, Calif., for 0.5 cubic foot per second from Dicus Pond to be diverted in Sec. 24, T 23 N, R 2 W, M. D. M., for agricultural purposes on 40 acres.

Application No. 5266 (Tuolumne County)—Turlock Irrigation District, Turlock, Calif., for 80,000 acre feet per annum from Middle Fk. of S. Fk. of Tuolumne River and Big Creek tributary to San Joaquin River to be diverted in Secs. 23 & 34, T 1 S, R 18 E, M. D. M., for irrigation purposes on 181,490 acres. Estimated cost $5,574,000.

Application No. 5267 (San Diego County)—S. W. Swan, c/o F. A. Wilkie, P. O. Box 735, National City, Calif., for 1.00 cubic foot per second from San Filipe Creek to be diverted in Sec. 5, T 13 S, R 4 E, S. B. M. for agricultural and domestic purposes on 35 acres. Estimated cost $50,000.

Application No. 5269 (Stanislaus County)—C. C. Crookshank, c/o L. J. Maddux, attorney, Modesto, Calif., for 2.54 cubic feet per second from Tuolumne River tributary to San Joaquin River to be diverted in Sec. 17, T 4 S, R 8 E, M. D. M. for agricultural purposes on 203 acres. Estimated cost $3,500.00.

Application No. 5270 (Butte County)—N. Stephenson, Biggs, Calif., for 0.37 cubic foot per second from Lateral "H" of Reclamation Dist. 833, tributary to Butte Creek and Sacramento River to be diverted in Sec. 24, T 18 N, R 2 E, M. D. M. for agricultural purposes on 30 acres. Estimated cost $600.

Application No. 5271 (Madera County)—Woman's Board of Home Missions of the Presbyterian Church in the U. S. A., 156 5th Ave., New York, N. Y., for 0.02 cubic foot per second from 2 springs tributary to Peckinpah Creek and San Joaquin River to be diverted in Sec. 17, T 8 S, R 23 E, M. D. M. for irrigation and domestic purposes on 4 acres. Estimated cost $500.

Application No. 5272 (Yuba County)—F. W. Johnstone of Walnut Creek, Calif., for 200 cubic feet per second and 10,000 acre feet per annum from Yuba River tributary to Feather River to be diverted in Sec. 30, T 16 N, R 6 E, M.D.M. for agricultural purposes on 15,000 acres. Estimated cost $250,000.

Application No. 5273 (Ventura County)—C. C. Capley, R. F. D. No. 3, Box 291, Pasadena, Calif., for .40 cubic foot per second from Tinta Creek tributary to Cuyama River to be diverted in Sec. 32, T 8 N, R 24 W, S.B.M. for irrigation and domestic purposes on 120 acres.

Application No. 5259 (Riverside County)—Winfield Hogaboom, as trustee and agent of Romola Water Co., c/o Hunter & Farraher, attorneys, 900 I. N. Van Nuys Bldg., Los Angeles, Calif., for 20 cubic feet per second from San Jacinto River to be diverted in Sec. 2, T 4 S, R 2 W, S. B. M. for irrigation and domestic purposes on 7000 acres. Estimated cost $190,000.

Application No. 5279 (Stanislaus County)—C. C. Turner, P. O. Box 142, Oakdale, Calif., for .69 cubic foot per second from Stanislaus River tributary to San Joaquin River to be diverted in Sec. 17, T 2 S, R 10 E, M. D. M. for agricultural purposes on 55 acres. Estimated cost $880.

Application No. 5280 (San Diego County)—Neil Rasmussen, c/o T. H. King, 920 8th St., San Diego, Calif., for 1.17 cubic feet per second from Viejas Creek tributary to Sweetwater River to be diverted in Sec. 30, T 15 S, R 3 E, S. B. M. for municipal purposes in Sandy Rock. Estimated cost $50,000.

Application No. 5281 (San Diego County)—Neil Rasmussen, c/o T. H. King, 920 8th St., San Diego, Calif., for .50 cubic foot per second from Viejas Creek tributary to Sweetwater River to be diverted in Sec. 35, T 15 S, R 2 E, S. B. M. for municipal purposes proposed subdivision. Estimated cost $20,000.

Application No. 5282 (Butte County)—C. M. Faris Estate, c/o Geo. D. Adams, 2131 F St., Sacramento, Calif., for 16.40 cubic feet per second from Lateral "E" of Reclamation Dist. 833 tributary to Butte Creek and Sacramento River to be divered in Sec. 26, T 18 N, R 2 E, M. D. M. for agricultural purposes on 656.2 acres of rice. Estimated cost $2,000.

Application No. 5284 (Madera, Merced and Mariposa Counties)—Webb & Sheller, La Grande, Calif., for 60,000 acre feet per annum from Chowchilla River tributary to San Joaquin River to be diverted in Sec. 18, T 7 S, R 20 E, M. D. M. for irrigation purposes on 20,000 acres. Estimated cost $400,000.

Application No. 5287 (Butte County)—Harry Howard, Chico, Calif., for .5 cubic foot per second from Dicus Pond to be diverted in Sec. 24, T 23 N, R 2 W, for irrigation purposes on 40 acres in Sec. 24.

Permits Issued

Among the permits to appropriate water issued by the Department of Public Works, Division of Water Rights, California, during the month of November, 1926, were the following:

Permit No. 2662, Application No. 4851 (Placer County) Issued to Pacific Gas & Electric Co., San Francisco, Calif., Nov. 10, 1926, for 300 acre feet per annum from Six Mile Valley in Sec. 25, T 17 N, R 12 E, for irrigation and domestic purposes. Estimated cost $1500.

Permit No. 2667, Application No. 4514 (El Dorado County) Issued to S. F. Akin, Placerville, Calif., Nov. 15, 1926, for .62 cubic foot per second from Cold Springs Branch in Sec. 2, T 10 N, R 10 E, for domestic and irrigation of 50 acres in Secs. 9 and 10. Estimated cost $150.

Permit No. 2668, Application No. 4903 (Los Angeles County) Issued to Haines Canyon Rock Co., Tujunga, Calif., Nov. 16, 1926, for .11 cubic foot per second from a well in Sec. 18, T 2 N, R 13 W, for industrial and domestic purposes in Sec. 18. Estimated cost $4500.

Permit No. 2670, Application No. 5031 (Sacramento County) Issued to Mary K. Deterding, Sacramento, Calif., Nov. 18, 1926, for 4.85 cubic feet per second from American River, movable point in Section 22 and 28, T 9 N, R 6 E, for irrigation of 387.79 acres near point of diversion. Estimated cost $3500.

Permit No. 2672, Application No. 5078 (Marin County) Issued to H. W. Thompson, Nicasio, Calif., Nov. 19, 1926, for .32 cubic foot per second from an unnamed stream in projected Sec. 1, T 2 N, R 8 W, for domestic and irrigation of 25.66 acres near point of diversion. Estimated cost $500.

Permit No. 2673, Application No. 5080 (Napa County) Issue to E. Bonzi, Napa, Calif., November 22, 1926, for 3.66 cubic feet per second from Putah Creek in Sec. 9, T 8 N, R 3 W, for irrigation of 293 acres near point of diversion. Estimated cost $3000.

Permit No. 2674, Application No. 5075 (Shasta County) Issued to D. J. Kirby, Castella, Calif., Nov. 22, 1926, for 0.1 cubic foot per second from North Fork of Castel Creek in Sec. 1, T 38 N, R 5 W, for domestic and irrigation of 8 acres near point of diversion. Estimated cost $500.

Permit No. 2675, Application No. 5201 (San Joaquin County) Issued to Fred H. Finck, Stockton, Calif., Nov. 23, 1926, for 3 cubic feet per second from Old River in Sec. 12, T 2 S, R 4 E, for irrigation of 245.3 acres near point of diversion. Estimated cost $4,000.

Permit No. 2677, Application No. 5001 (Alameda County) Issued to County of Alameda, Oakland, Calif., Nov. 26, 1926, for .5 cubic foot per second and 60 acre feet per annum from Arroyo del Valle, in Sec. 4, T 4 S, R 2 E, M. D. M. for domestic and irrigation of 65.85 acres in Secs. 3 and 4. Estimated cost $30,000.

Whittier Water Company has applied to the California Railroad Commission for authority to issue $70,000 of notes for the purpose of renewing outstanding notes and $16,500 of notes payable in three years, for the purpose of financing improvements.

Coverage with "Overhead"

(*Continued from Page 50*)

tion from a single head must have a diameter equal to about three and one-third times the distance between the trees. With trees planted on 24-foot distances, for example, the diameter of application required would be about 80 feet, and undesirable inequalities in application would necessarily result.

Some manufacturers, particularly those who specialize in sprinkling devices for golf greens, offer sprinklers with great diameters of coverage for orchard use. The advantage in using such heads lies in economy in underground piping. The great disadvantage is that undesirable inequalities of distribution must exist if the sprinkling heads be located with respect to existing tree rows. In some installations with large-diameter heads, a dry area is allowed to remain between the circles covered by four large sprinklers. This dry area is covered by a small sprinkler fed from a lateral leading from the nearest main.

Legal and Judicial News

(*Continued from Page 48*)

point and in support of the verdict, the Supreme Court states:

It is asserted that the amount of the verdict shows that it was given under the influence of passion and prejudice, and it is pointed out that the damages awarded for a partial loss of crops would equal or exceed the purchase price of the land on which the crops were grown, including the water right. The purchase price of the land, or its value, cannot affect the value of crops raised thereon. It is not beyond the realm of possibility that a purchaser might pay the entire purchase price of his land and water right out of three years' crops. The question for determination is whether, under the evidence adduced, the amount awarded is justified.

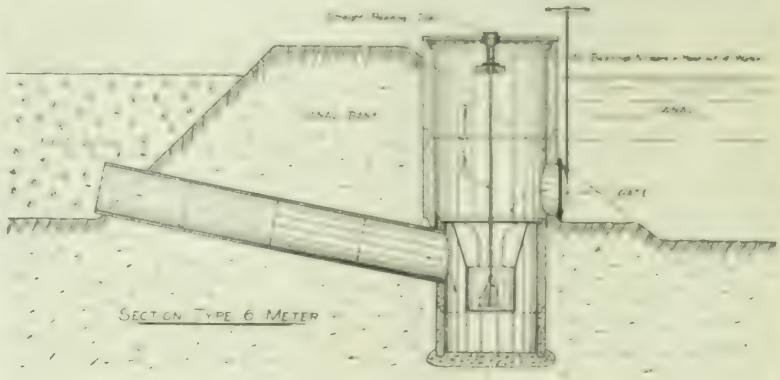
Vista Uses "Rule of Reason"

(*Continued from Page 17*)

vised as a "speeding up" measure. Undoubtedly this bonus has had the desired effect for a rush of applications have been filed to secure this advantage during the first year. In the interval from the completion of the system in March, applications covering 7283 acres have been made and something over 275 individual service meters have been installed.

Meeting some opposition from the land owners at the outset because of the novelty of the plan and failure to grasp the manifest advantages to the small land owner, the results have been so satisfactory and the advantages so apparent that much of the rapid advancement of the district is ascribed by those most closely associated with the enterprise, to this ingenious handling of a perplexing business problem.

The RELIANCE METER



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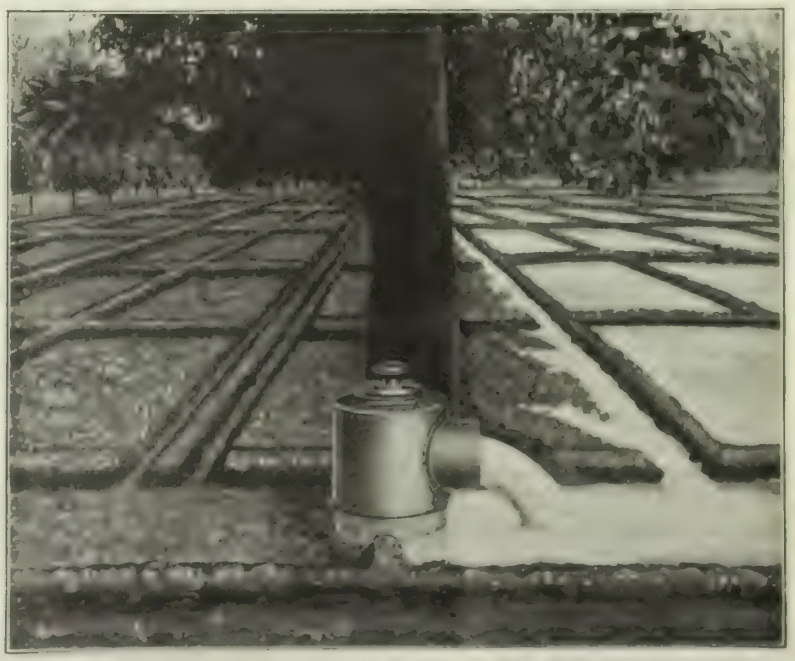

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Corrosion Problems of a Water System

(*Continued from Page 33*)

passing very close to the rails will have large stray currents, and these currents are likely to leave over restricted areas, causing more concentrated corrosion.

The current strength in pipes cannot always be used as an index of electrolysis hazards. Relatively large currents may be flowing on a pipe without causing any corresponding damage for the reason that these currents do not flow to the soil. On the other hand, relatively small currents may be flowing along the main and yet corrosion may be taking place.

Heretofore our greatest difficulty encountered in electrolysis testing has been our inability to measure directly the factor responsible for the corrosion, namely, the density of the current flowing from a pipe to earth. It was evident, therefore, that there was a need for improved means of electrolysis testing, whereby it would be possible to determine the polarity of the pipe with respect to earth, and for the quantitative measurement of current density at any desired point in the earth.

An earth current meter was developed by Burton McCollum of the United States Bureau of Standards and was described in some detail in the Electric Railway Journal of November 21, 1921. This instrument enables one to determine the actual density of current discharge from the pipe which is measured in terms of milliamperes per square foot of pipe surface. We have used this instrument for electrolysis testing for the past two years and have found it to be well adapted for use under practical conditions. By the use of this instrument, information can be had showing far more definitely the actual electrolysis conditions prevailing on any particular point than it is possible to secure by any other means heretofore available. This instrument is the best means available whereby it is possible to differentiate between natural soil corrosion and corrosion from stray currents.

Cooperative Treatment

When stray current flows into the earth, many different utilities owning underground structures are affected; hence the problem of electrolysis is one which is preeminently adapted to cooperative treatment. When each interest cares for its problem independently then each is partly undoing the work of others and a condition arises where money is being spent in producing systems that afford only temporary relief.

Such a condition is to be found where each utility attempts to apply to drainage system independent of all other utilities. It is easy to understand how confusion often arises when, say three companies apply drainage systems independent of each other, and large differences of potential exist between them. The three systems are in many ways in conflict, and very often rapid corrosion takes place.

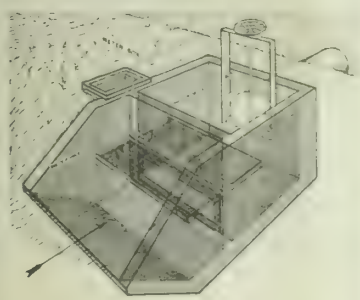
Troubles in various utilities finally reached a point when it was realized that stray electric currents could be best controlled by coordination of effort on the part of all interests. As a result a committee of representatives of all interested utilities in the East Bay Cities was organized in 1922 to determine the causes of damage to underground structures and recommend measures for their mitigation through means of cooperation among the interests concerned. Such assistance in the way of testing instruments, engineers, draftsmen, field employees, transportation and office space are contributed by the various member organizations. This committee holds monthly meetings to discuss the technical phases in connection with reports of tests and investigations that have been made during the current month and makes recommendations for protective measures. It recommends tests and investigations to be made and indicates the methods to be followed in making such tests and investigations.

How Committee Works

Regular surveys are made of the railway systems and the various underground structure systems, and include such measurements as: Current of station loads, rail gradients, overall potentials, difference of potential between rails and underground structures, current on underground structures, difference of potential between different structures and earth current measurements. These tests comprise to date over 2000 24-hour recording charts and 6000 readings from indicating meters. Test on railway systems required over 800,000 feet of wire which had to be strung on pole lines.

In addition to regular tests, this committee also investigates special cases of corrosion and installs pilot wires and drainage cables. Many serious cases have been corrected through committee activities at a minimum of expense to the interests affected.

The work of this committee has rendered valuable service in the installation and maintenance of drainage systems. An agreement was reached whereby drainage cables from the various underground structures were run to the most convenient manhole, either telephone or electric light and these connected to the



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negative return on a common bus bar. Such an arrangement makes it possible to insert resistance grids in series with drainage cables in order to equalize the potential between various underground structures.

This committee makes monthly tests of return current on all drainage systems as a precaution against damage from broken drainage connections or unusually large currents being drained due to changes or additions to the various structures. Tests are taken periodically to check the voltage conditions existing between the various structures, and steps are immediately taken to correct any dangerous conditions that might be found.

Cooperative treatment of electrolysis problems has been proven successful in a number of cities throughout the country, and is now generally recognized as representing the best practice in electrolysis prevention.

Water for Special Purposes

(Continued from Page 29)

portion of the crop area is in alfalfa, as in the San Joaquin and Imperial Valleys, greater amounts are used, varying from 2 to 3 feet depth per annum delivered at the land.

The question as to the relative quantity of water which will be required when an irrigated area is annexed to a growing city, with the prospect of the land being subdivided and used for other purposes, is one of growing importance. The past experience at Los Angeles has been, that as irrigated lands are subdivided and become residential in character with one-family houses surrounded by lawns and gardens, the water requirement remains unchanged or at least does not exceed that for irrigation. The data assembled in this paper confirm this experience and indicate that the same rule would hold for residential cities generally in California, including those in the region of San Francisco Bay.

The rule does not hold, however, for cities with population density exceeding 9 or 10 per acre. In such communities the population has begun to live on more than one floor level, apartment houses and flats are in evidence and commercial activities and industries have become established with greater demands upon the water supply.

For residential cities in California the rule will probably continue to hold, but as such cities become more metropolitan in character, and industries are established, there will undoubtedly be a change. There are thus very definite limits within which urban water requirements can be considered as acre for acre identical with that for irrigation.

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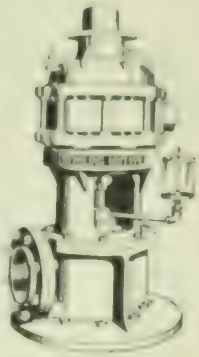

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NOTE—The motor drive for this vertical pump interchanges with the deep well Turbine Drive.

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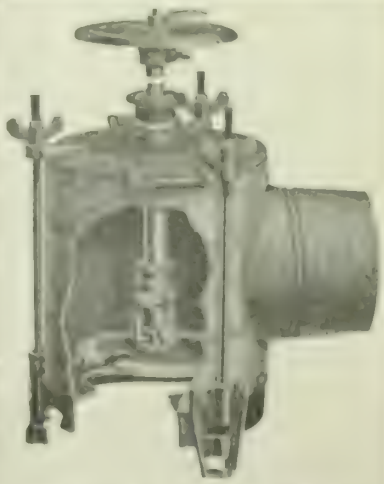

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AMONG OUR CONTRIBUTORS

Editorial Jottings About Current and Forthcoming Feature Articles, Dealing With Practical Problems of Hydraulics, and the Men Who Have Written Them

MAJOR CHARLES R. OLBERG, who furnished the information for the staff article on the Coolidge Dam, is assistant chief engineer with the U. S. Indian service. He was graduated from George Washington University in 1900 and was appointed structural draftsman in the Supervising Architect's office, of Washington. The next year he was made assistant hydrographer with the U. S. Geological Survey, and in 1902 he became assistant engineer with the U. S. Reclamation Service. In 1905 he was appointed structural engineer in the United States Quartermaster's Corps. In 1907 he was made supervising engineer with the U. S. Indian Service, a position he held until the United States entered the World War. During the war he was captain and then major in the engineering forces. Since 1919 he has held his present position of assistant chief engineer with the U. S. Indian Service.

Major Olberg's career has been marked by many important achievements. He was in charge of the preliminary work, including the design, of the Roosevelt dam; he constructed the Ashurst-Hayden Dam; and was in charge of the design and part of the construction of the Sacaton dam and bridge. These three projects, as well as the one on which he is engaged at present, the San Carlos project, are located in Arizona. Major Olberg is known as the inventor of a design for pumping from rivers, and an erosion control method, as well as of the multiple-dome type of dam.

GEORGE S. HENRY, who contributed last month an account of the water allocation problem of the Vista Irrigation district writes in this issue of some of the management problems of the district. Mr. Henry is *ex*-president of the Vista Irrigation district and not its president, as was erroneously stated in the last issue.

LOUIS MEYER, author of the article entitled "Melones Dam Completion Marks End of War Between Districts and Power Companies," has been an interested observer of activities on the Melones project from its earliest inception. As publisher of the Oakdale *Leader*, he has contacted with the financial, technical and construction sides of the work on the dam through every stage of its progress, and he reports the story to the readers of MODERN IRRIGATION in a popular and non-technical style which reveals, nevertheless, a familiarity with the history and the development of the project in all of its several interesting phases.

GEORGE W. TRAUGER

Mr. Trauger is superintendent of the Lindsay Strathmore Irrigation District in California. His paper on "Problems of a Sub-Surface Water Supply," read before the recent annual meeting of the California Section, American Water Works Association, is published in this issue through the courtesy of the editor of the Journal of the American Water Works Association.

H. A. WADSWORTH, who writes on "Coverage in Overhead Sprinkling," has prepared a bulletin, published by the California Agricultural Extension Service, on "Irrigation by Overhead Sprinkling," which is said to be one of the most comprehensive discussions of the subject as a whole that has yet appeared. His article in this issue is an excerpt from that bulletin. Mr. Wadsworth is assistant professor of Irrigation Investigations and Practice in the College of Agriculture, University of California, and is also assistant irrigation engineer in the Experiment Station of the University.

CHARLES H. LEE, who contributes the "Data on the Use of Water for Special Purposes" is well known to the readers of MODERN IRRIGATION. Through his many years of experience with the various phases of the water problem he is enabled to speak with authority on the subject. A graduate of the University of California, he was appointed hydrographer with the U. S. Geological Survey in 1905. In 1906 he became a member of the engineering staff of the Los Angeles aqueduct. In 1912 he was put in charge of underground water investigations of the California State Conservation Commission in Southern California. In 1919, on his return from service with the American Expeditionary Forces in France, he was made president of the California State Water Commission, and later became chief of the Division of Water Rights, State Department of Public Works. Mr. Lee is at present engaged in private practice as consulting engineer in San Francisco.

IN AN EARLY ISSUE, MODERN IRRIGATION expects to have an account of the very interesting irrigation system on the ranch of W. K. Kellogg, near Spadra, California. The novel feature of this installation is its remote automatic control which reduces to a minimum the possibilities of human error. This account has been written for the magazine by Adolf H. Koebig, senior partner of the firm of Koebig and Koebig, who designed the system. Mr. Koebig has his engineering degree from the University of Karlsruhe, Baden, and has followed his profession in Germany and the United States for more than fifty years, during some forty of which he has been a noted figure in engineering circles in Southern California.

AMONG THE OTHER interesting features in our forthcoming numbers will be an article by A. K. Warren, chief engineer of the Bureau of Sanitation, Los Angeles County, giving a detailed account of the new sewage treatment plant being constructed south of Watts, Calif.